Induced Voltage Of Overhead De-energized Transmission Lines Due To Inductive And Capacitive Coupling

Susan Han[1], Matthew Davis[1], Jonathan Glassman[1]

[1]Exponent

Abstract

The utility company may shut off power in the overhead transmission or distribution lines as a preventative measure against wildfire risks and to ensure public safety. However, the de-energized transmission lines can still carry energy due to induced voltage from the electric- and magnetic-fields emitted from nearby energized lines. Fallen de-energized lines can pose an ignition risk to combustible material on the ground .

This presentation discusses the use of COMSOL (Electrostatics, Boundary Elements and Magnetic Fields interfaces in the AC/DC module) to calculate voltages induced on de-energized lines from nearby energized lines using various realistic transmission line configurations. Specifically, for conductor geometry, we examined the distance between the energized and de-energized lines, phase configuration, height above ground level, and line angle. The predicted induced voltage can serve as an input to the electrical and thermal arcing models to calculate of the probability of ignition. This work ultimately was used to validate a three-dimensional, grid-scale model of the overhead electric transmission system that was deployed in purpose-built code to quantify ignition probabilities across an entire service territory.

Reference

1. Golder Associates Inc. Induced Voltage and Current Report - A Review of Public Hazards Associated with High-Voltage Transmission Lines. Oregon Department of Energy. 073-99810-29 and 073-99810-31, 2013.
2. Allen Taflove, Prediction Method For Buried Pipeline Voltages Due To 60 Hz AC Inductive Couling. IEEE Transaction on Power Apparatus and Systems, Vol. PAS-98, No. 3, 1979.
3. Xuan Wu, et al., Transient Analysis of Inductive Induced Voltage between Power Line and Nearby Pipeline. Electrical Power and Energy Systems. Vol. 84, No. 47-54, 2017.
4. Mazen Abdel-Salam, Abdallah Al-Shehri. Induced Voltages on Fence Wires and Pipelines by AC Power Transmission Lines. Vol. 30, No. 2, 1994.

Figures used in the abstract

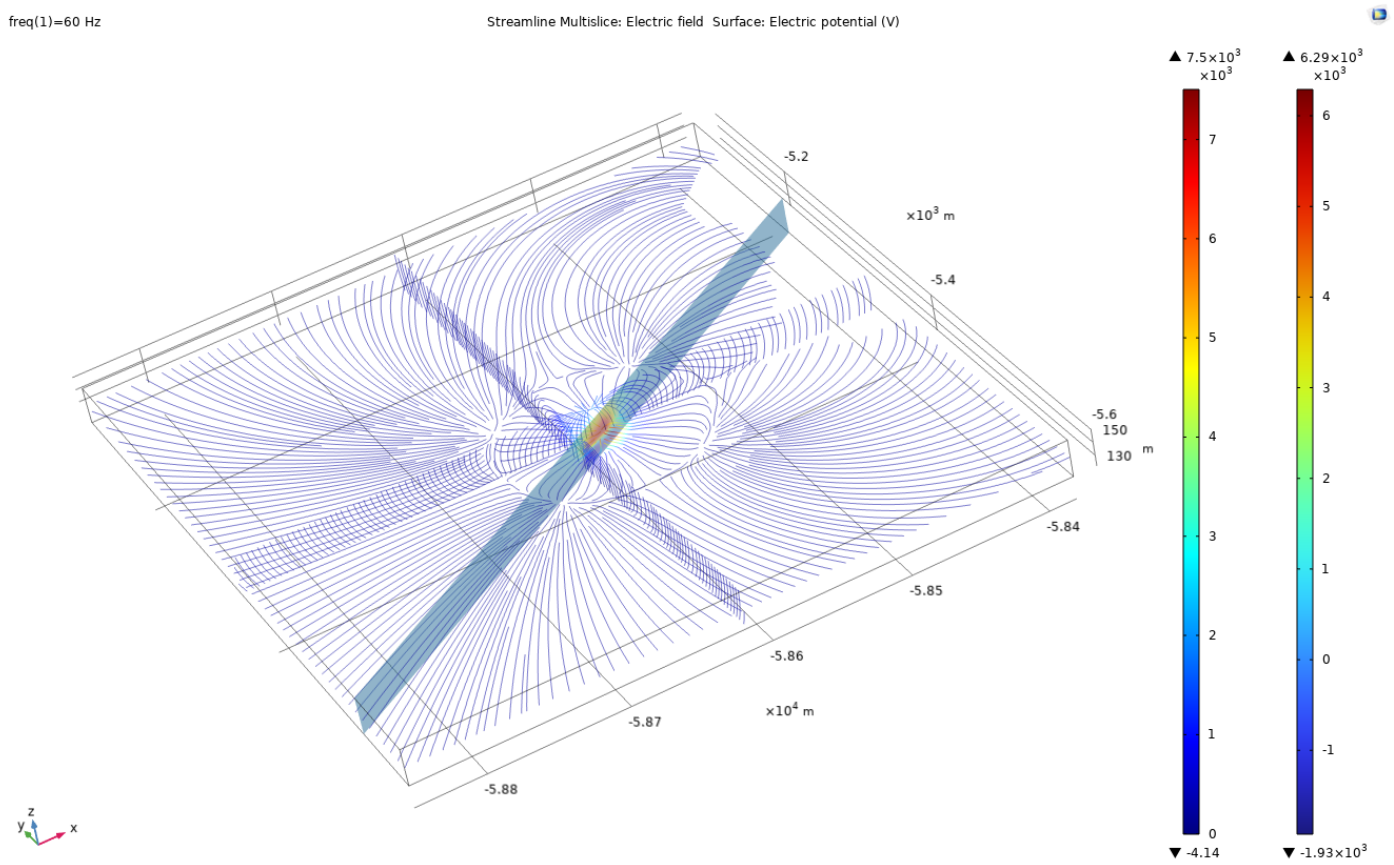

Figure 1 : Electric potential distribution (additional figures will be uploaded upon acceptance)

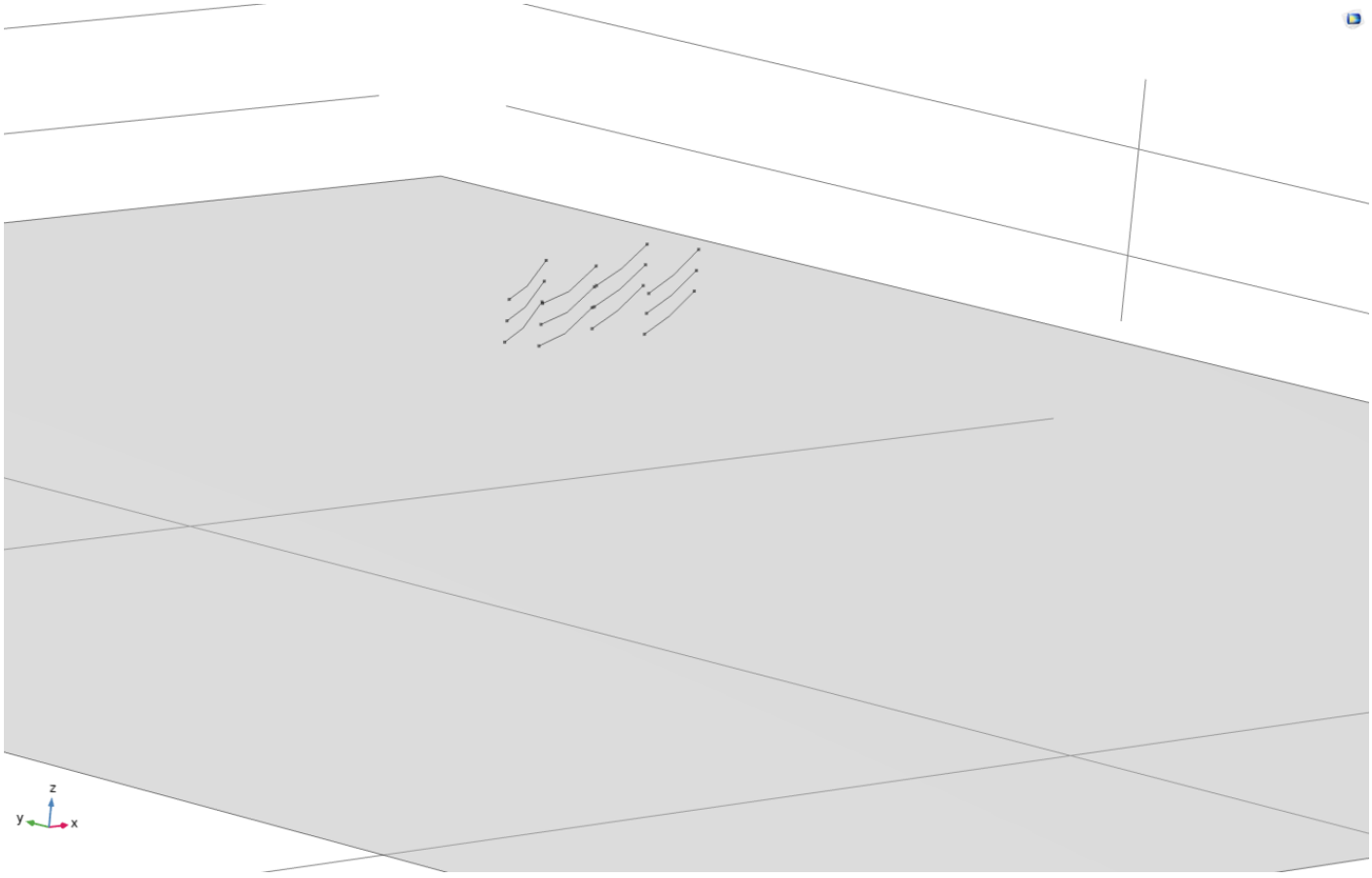

Figure 2 : Geometry setup of energized and de-energized transmission lines (3 phases)