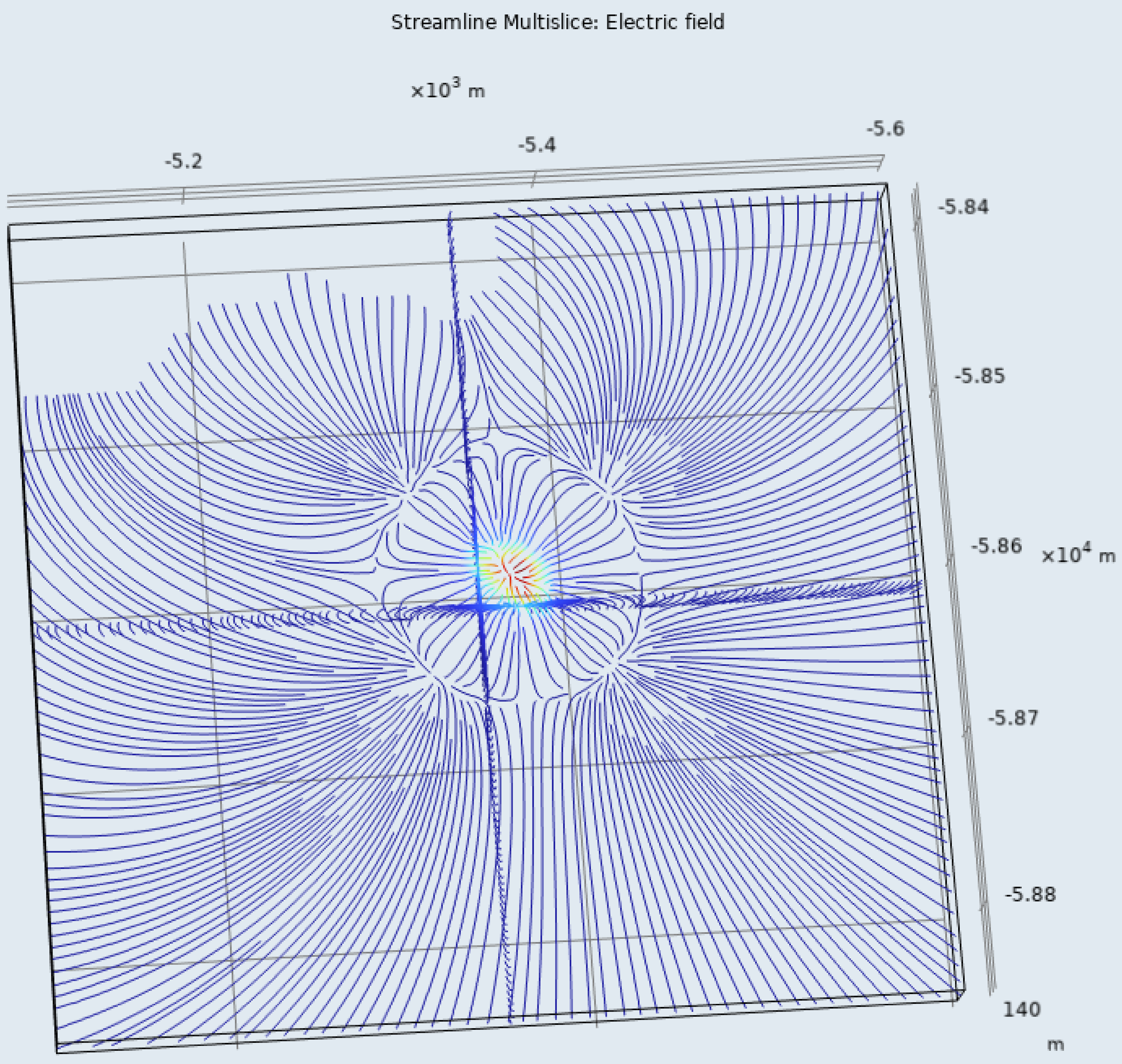

Induced Voltage of Overhead De-energized Transmission Lines

Investigate wildfire risks and public hazard by quantifying the voltages induced on de-energized lines from nearby energized lines under a public safety power shutoff situation

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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, which pose an ignition risk should they fall and contact combustible ground fuels.

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. The predicted induced voltage can serve as an input to the electrical and thermal arcing models to calculate of the probability of ignition.

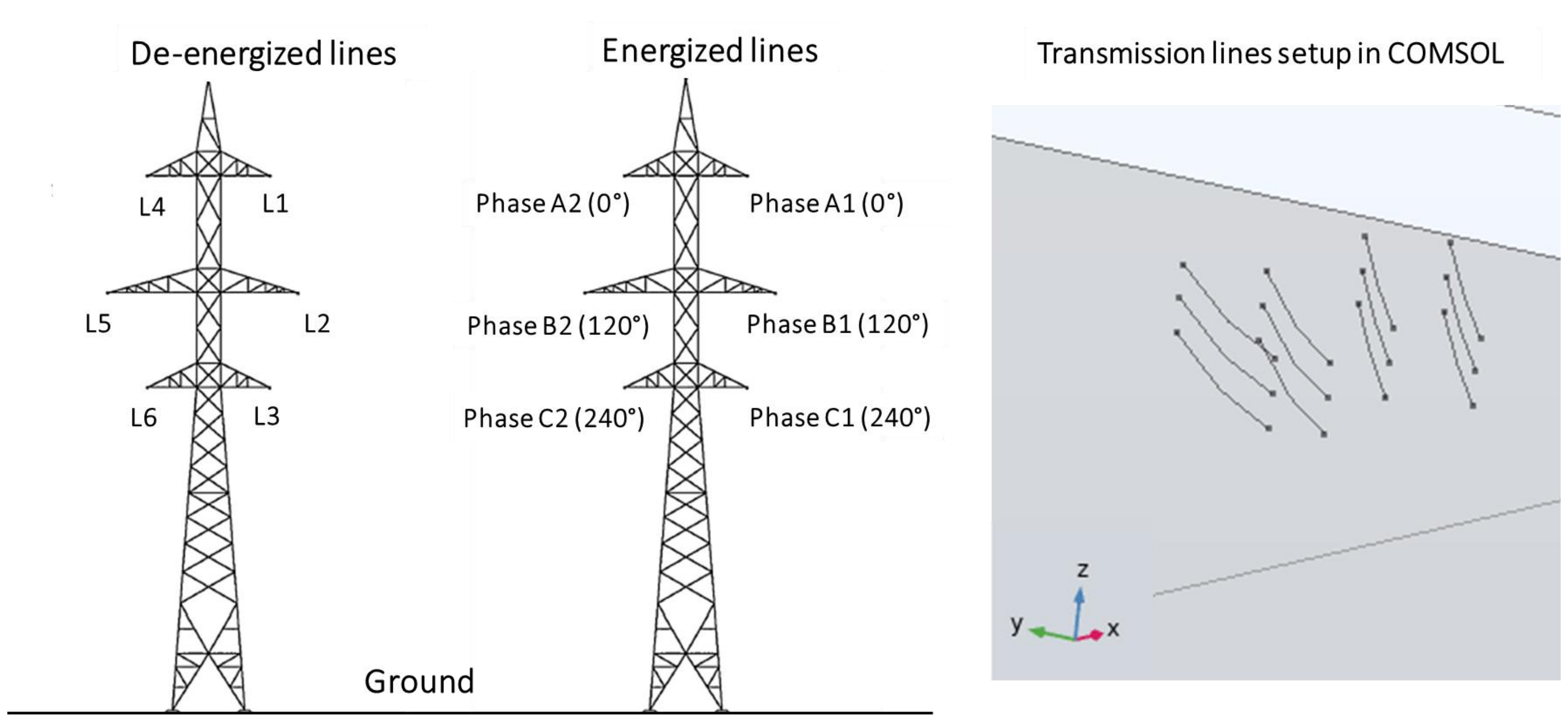

Figure 1. Phase configuration and spatial arrangement of the realistic transmission lines and their 3D setup in COMSOL.

Methodology

The induced voltage on the de-energized transmission lines due to the emitted electric fields from nearby energized lines was modeled with:

$$\nabla \cdot (-\varepsilon_0 \varepsilon_r \nabla V) = \rho$$

The induced voltage due to the emitted magnetic fields was modeled with 's law

$$(j\omega\sigma - \omega^2 \varepsilon_0)A + \nabla \times \left(\frac{1}{\mu} \nabla \times \boldsymbol{A}\right) = J$$

The distance between the energized and de-energized lines, phase configuration, height above ground level, and line angle were examined.

Results

Two straight parallel transmission lines were evaluated at various lengths and at varying distances (d) from each other and height (h) above ground. One of the lines is energized to 115 kV while the other is de-energized and floating. The induced voltage on the de-energized floating line is shown in Figure 2 for selected configurations.

As the distance between the two transmission lines decreases, the floating voltage on the de-energized line increases quickly. A similar trend in the floating voltage was observed as the distance from the transmission lines to the ground decreases. In most cases, the floating voltage is in the kilo-volts range and increases as the conductor lines extends.

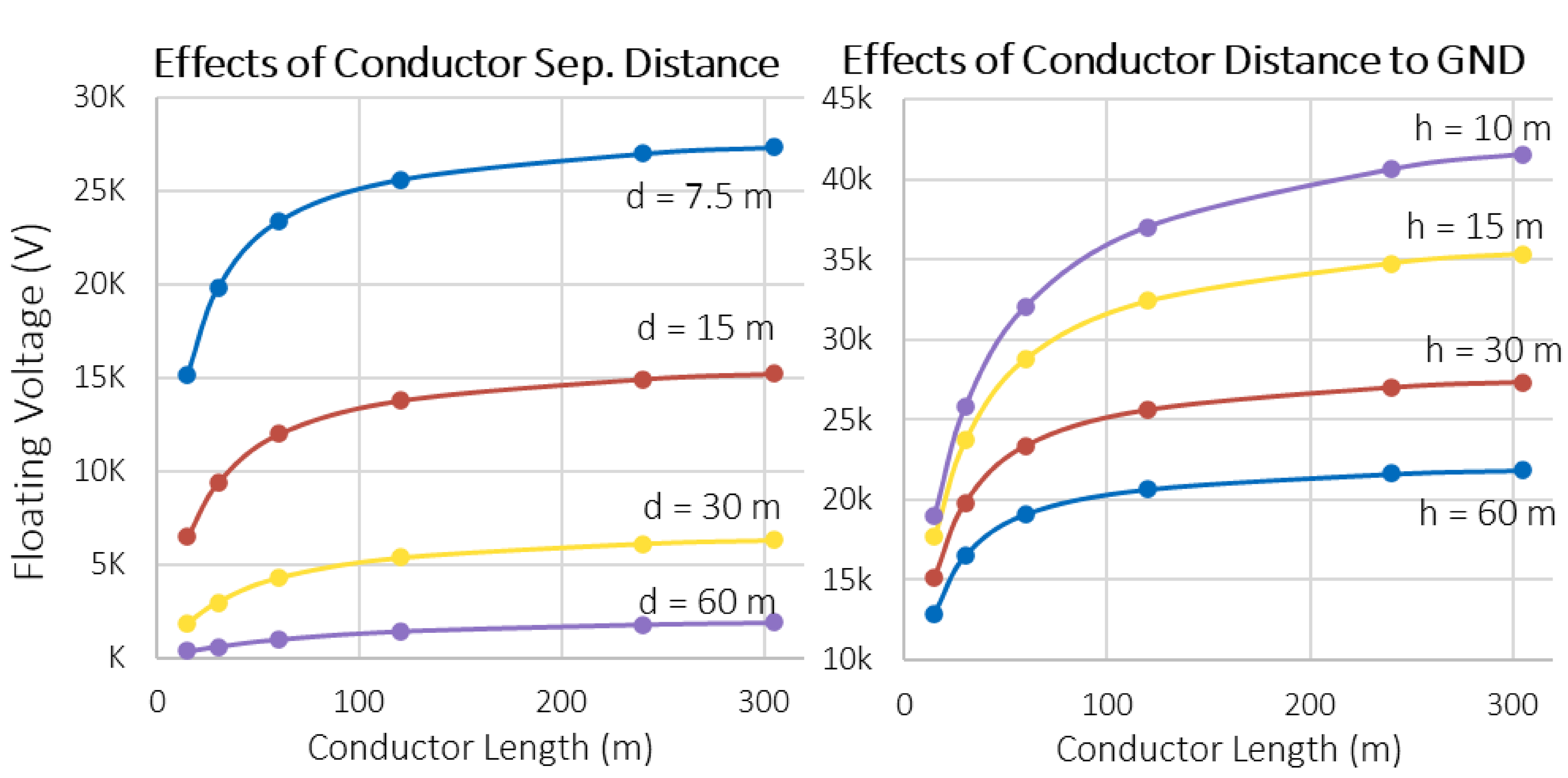

Figure 2. Floating voltage induced on a de-energized straight transmission line parallel with another transmission line energized to 115 kV. Various factors were investigated.

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