













negligible before reaching Terminators T3/T4 (Table II). Taking  $I_S = 60$  A,  $l = 400$  m, and the same transfer impedance, the surge voltage is 1.4 kV, which is below the withstand level.

## V. CONCLUSIONS

The paper presents the study on the lightning threat to the electronic intrusion detection system based on underground cable sensors built of the coaxial cables. The threat is related to the nearby lightning strike to the pole of the lighting system installed in parallel with the sensory cables. In the extensive intrusion detection system working in a network composed of several controller-sensor-terminator units, a problem arises, whether the neighbouring units should or should not be connected galvanically in order the system is less vulnerable to the effects of the lightning electromagnetic pulse. The problem is complex. It has been studied with numerical simulations based on the electromagnetic field theory.

The results show that there is no danger of either thermal or electromechanical effects caused by the surge currents in either configuration. The peak values of the currents do not exceed 430 A and 360 A for the configurations with and without the galvanic continuity, respectively.

There is also no serious threat of the electrical breakdown of the insulation between the terminators and sensory cables running nearby (40 kV), as well as of the insulation of cables running close to the point of the strike (potential of the grounding electrode of approximately 80 kV). The obtained values are below the expected value of the electrical breakdown for the polyethylene insulation.

The threat of the breakdown of the controller's interface measured by the surge voltage between the inner and outer conductors of the sensory cable, has been assessed on the basis of the typical transfer impedance and the current flowing in the outer conductor. The calculated surge voltages are 3.4 kV for the configuration with the galvanic continuity and 1.4 kV for the isolated one. Hence, the isolated configuration seems better.

However, it should be kept in mind that the obtained results are valid only for a specific situation, particularly related to the point of the strike, the waveform of the lightning current, and soil resistivity. Higher threat levels might occur for higher soil resistivity and higher steepness of the lightning current waveform. These factors are the subject for further research.

## CONFLICTS OF INTEREST

The author declares that she has no conflicts of interest.

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