



Electromagnetic Fields:

Principles, Engineering Applications and Biophysical Effects

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Chapter 4: Magnetic Field Originated by Power Lines (pp. 169-202)

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ABSTRACT: Danger to human health from living near to high-voltage power lines has been a matter of concern and controversy over the past years; exposure to magnetic fields produced by power lines has been suspected of increasing the risk of cancer. Guidelines, put forward by the International Commission of Non Ionizing Radiation Protection, have been established for safe public exposure to power-frequency magnetic fields. This chapter starts with electromagnetic field equations to explain how magnetic fields can be deleterious for human health, and how the operating frequency plays a decisive role for that matter. Next, an analysis of the magnetic field originated by the current-carrying conductors of a high-voltage single-circuit three-phase overhead power line is thoroughly developed. The analysis takes into account the effect of protective ground wires, the effect of earth return currents and, furthermore, incorporates the non-uniform character of the power line structure arising from conductor sagging between towers. For magnetic field evaluation purposes, matrix techniques are made use in order to implement multi-conductor transmission line theory –a key tool for this subject. Mitigation techniques usually employed to decrease magnetic field levels are also addressed, namely, mitigation loops with or without compensation capacitors. Graphical and numerical computation results concerning magnetic field evaluation are presented and discussed, not only for the fundamental power frequency of 50 Hz, but also for higher order harmonics, up to 800 Hz. In the latter case, balanced and unbalanced line loads are considered. Underground power cables do not have as a visual impact as overhead power lines, nonetheless, they too originate a magnetic field above the ground surface –this aspect is also paid attention.