

Biological Effects from Exposure to Transmission Line Electromagnetic Fields

by Morton W. Miller

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The right of way agent is often the first utility contact a landowner has when plans call for the routing, construction, and operation of a transmission line across his property. Once public need and necessity are determined the proposed line's routing becomes an important issue. Construction follows route selection, and operation and maintenance considerations come last.

Clearly, the construction of a transmission line involves a number of potential impacts to the land and its owner. The land must often be cleared within a right of way, an access road must sometimes be made to insure maintenance capability, the soil can often be compacted due to the use of heavy equipment involved in tower erection and line stringing. Additionally, there is the possibility of some interference with agri-

cultural practices due to the presence of the towers, and aesthetic qualities can be compromised by the presence of such lines. These "effects of construction and maintenance" are well recognized by the utilities and landowners alike.

A second "effect" which is recognized by the utilities is the issue of electric shock. The lines are strung so as to be normally out of reach of individuals, and signs are posted on towers warning of "high voltage." Occasionally, accidents such as an irrigation worker inadvertently manipulating a pipe into the lines occur, often with lethal consequences. Again, this is a recognized problem by all parties. Additionally, there is the problem of people getting shocked from touching ungrounded structures and vehicles which are in the high fields associated with transmission lines [51].

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And again, the problem is recognized and procedures and regulations exist for obviating harmful effects.

The issue of corona effects is also well recognized [51]. Transmission lines, particularly the very high voltage ones, can sometimes be somewhat noisy during foul weather. The noise results from the development of surface irregularities on the wire and the consequent very local enhancement of electric fields at that point. These conditions result in a very localized, on-the-wire breakdown of air, with the resultant production of a slight hiss and the potential development of radio and television interference. The most noticeable interference usually occurs in areas of normally fringe reception. Again, these are recognized problems associated with the operation of transmission lines,

and steps can be taken to mitigate against them.

The issue of biological effects from exposure to transmission line electric and magnetic fields is NOT a recognized problem. To date, no specific deleterious biological effect has been identified as having been caused by the electric and magnetic fields associated with transmission lines. Yet, strangely, this issue has received considerable press coverage and has been strongly contested in a number of hearings and trials across the country. The purpose of this article, then, is to discuss this latter issue in light of what is known about the effects and mechanisms of action of electric and magnetic fields on people, plants, and animals.

It's very important to recognize that transmission line electric fields can cause biological effects. They in no way can be construed as detrimental, and include the following: 1) Hair Vibration: Under some very large transmission lines it may be possible to feel the hair on one's neck (or face, or out-stretched arm) vibrating. This effect is caused by electrostatic repulsion of the charge on the surface of the hair at unperturbed electric field strengths of about 7 kV/m or more [51] and has a slightly greater chance of occurrence if the arm is raised over the head. The effect of hair vibration has been likened to that of a gentle breeze across the arm. 2) Leaf Tip Corona: Trees and shrubs, if they grow high enough under or very near the wires, may experience "leaf tip corona" on the very tallest leaves. Only the tallest leaves (and generally they must be pointed) experience this effect, which amounts to a 1-2 mm "burn" at the tip of the leaf [49, 52]. This effect is about equivalent to an insect bite or fertilizer burn, and does not appear to interfere with the growth of the plants. Indeed, if left to grow unheeded, trees and tall shrubs will grow to a size where flashover from the line to the tree can occur [51]. Trees and shrubs are normally periodically cut down or chemically treated to prevent such growth. 3) Shock: Transient and steady state shocks may result from a person's contacting a vehicle

parked in the maximum field of the line [51]. Clearly, this a recognized problem, and the National Electrical Safety Code requires that the steady state short circuit current from the largest anticipated vehicle under the line NOT exceed 5 milliAmps (a level which is considered below the let-go level for adults). Thus, even this recognized problem does not appear to have serious consequences since allowance is made for release of the vehicle. 4) Cardiac Pacer Interference: Some cardiac pacers may be sensitive to the electric fields of transmission lines; many pacers appear insensitive to them [53]. Some types of modern cardiac pacers are built to sense the electrical signals from the heart when it is beating; but, absent a normal heart beat, the pacer will provide an electrical stimulus to the heart to initiate its contraction. Thus, some pacers are designed such that they are inherently sensitive to electric fields. Obviously, a person walking in the environment of a large trans-

mission line, can have an induced electric field. If the induced field is sufficiently large, the pacer may revert to a fixed mode of operation--i.e., provides "beats" whether or not they're needed. Competitive pacing can result, which means that the heart and the pacer both provide electrical signals. This is obviously not optimal but does not appear to be considered a serious hazard to the patient. That some pacers are insensitive to the electric fields of transmission lines signifies that this particular problem of possible interference can be solved by the designers of pacers. Transmission lines represent only one of many sources of possible electromagnetic interference to pacers. People who wear pacers should probably consult with their physician if they expect to be in the right of way of large transmission lines.

We come now to the issue of the potential for the electric and magnetic fields of transmission lines to cause biological effects, for



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