TECHNICAL PERSPECTIVE #4
THE ROLE OF ENGINEERING RESEARCH IN RISK EVALUATION

Paul Gailey
Oak Ridge National Laboratory
Oak Ridge, TN

The field of EMF research presents the engineer or physicist with a problem: in order to help determine whether there are EMF health effects, we must know the proper dose metric or dose/response relationship. However, that information is currently lacking.

In this context, we must ask two questions:

- What should the goals of EMF engineering research be?
- What do we hope to learn that will assist in answering questions about potential health risks?

In a less complex world, solutions to such problems are easier. If the dose metric is known, we have a single, measurable quantity. Where the dose-response is known, it is generally a monotonically increasing function. Under these circumstances, the path of action is clearer:

- Conduct animal studies, using a high dose of appropriate quantity.
- Estimate the dose/response relationship.
- Set standards at a level significantly below the known harm level.

Examples with different dose/response characteristics where such steps might apply include ionizing radiation, with an increase in mutation rate as the dose increases; cocaine sensitivity, which decreases as dose increases; and melatonin, which exhibits daily peaking pattern response and the possibility of phase resetting with carefully timed brief exposures. Another alternative for response would be a threshold model, with no effects at low doses.

Given our poor understanding of dose/response relationships for EMF, it is not clear how to mitigate or how to regulate. Questions arise as to which field parameter to investigate or mitigate for; how to define a "safe level"; and what changes might occur in other relevant parameters when mitigation is undertaken for a single parameter. (A prime example of this last problem is found in newer electric blankets, which have been re-engineered to produce lower magnetic fields: both induced current densities and electric field strengths have increased as a result of the new "low field" design, and high-frequency transients are uncontrolled in both designs.)

Regulation of EMF poses additional problems where a number of sources could be identified as contributing to a given field or where the consumer controls use. Finally, there are no criteria for gauging the cost/benefit of field reduction.

Research in a laboratory setting may isolate a single parameter for investigation. However, in the real world, there exists a multitude of parameters to which attention might be paid. For instance, the dose metric could be TWA; time-above-threshold; some measure of transients, of coherency, or of intermittency; a combination of field conditions (including geomagnetic field or radio frequency); and/or biological state, circadian cycle, and so on. Similarly, problems for mitigation are complicated by the fact that we do not know which field parameter to reduce, or to a point below what level.

The engineer must therefore adopt a "real-world" approach to research. The following suggest appropriate tasks and goals for engineering research:

- Integrate EMF engineering research into an iterative process with biological research.
- Characterize the EMF environment and provide information to laboratory researchers.
- "Look for" metrics suggested by laboratory research in the environment.
- Assist in the interpretation of epidemiology studies.

While epidemiology studies provide information about suggested health risks, and laboratory studies improve our understanding of reported biological effects and potentially important metrics, engineering studies can begin characterizing environmental fields in terms of 60-Hz fields, intermittency, AC/DC field combination, transients, and other parameters. Additionally, they can help determine the relationships between field parameters and wire-code classification, transmission-line proximity, modeled TWA, and other surrogates for exposure. The epidemiology/biology research and engineering research should provide information and ideas to each other to produce a richly detailed body of information that will yield progress in the field.