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Risk Research: When Should We Say "Enough"?

In response to legitimate concerns, government often undertakes programs of applied research to investigate suspected hazards. Such programs should not be started without some reasonable expectation that useful understanding can be obtained at an affordable price. Once started, when is government justified in stopping? If a risk is clearly demonstrated, the answer is straightforward. But suppose that after significant effect a risk is not demonstrated. When should we say "enough"? In programs of applied risk research, the failure to ask or answer this question can lead to serious social consequences.

A good example is provided by the suggestion that exposure to the 60-hertz electromagnetic fields from power lines, wiring, and appliances may pose health risks.* For several years the Department of Energy, the Environmental Protection Agency, the State of New York, and others, including the Electric Power Research Institute, have invested heavily in research examining this issue. The research has not demonstrated that a hazard exists, but it has demonstrated that under a variety of specific circumstances low-frequency fields can produce changes in living systems. Some of these appear to involve nonlinear transductive coupling at cell surfaces in relatively weak fields. The results are complicated by experimental evidence which suggests that if there should turn out to be adverse health impacts, stronger fields might not be "worse" than weaker fields, and various resonant and dynamic process may be important. A large number of laboratory animal screening studies have, with a few ambiguous exceptions, failed to turn up indications of adverse health impacts. A series of epidemiological studies purporting to link long-term 60-hertz magnetic field exposure with certain cancers are decidedly inconclusive. At the moment, the scientific evidence neither clearly indicates that there is a significant risk, nor clearly indicates that there is little or no risk posed by 60-hertz field exposures. It does not even offer many suggestions about what we should do if we want to "play it safe," since unlike most chemical hazards, in this case we probably cannot assume that "if it's bad, more is worse."

Having created a large inconclusive data set, and in the process having got a lot of people concerned, government research programs in this area are now being cut back or eliminated because of budgetary constraints. At the same time, growing public concern has prompted several state regulatory agencies to arbitrarily impose regulations on power line fields. The courts are also involved. Last November a county court in Texas ordered a utility to pay $25 million in punitive damages on the grounds that in building a 345-kilovolt line within 60 meters of a school the utility had acted "with callous disregard for the safety, health and well-being of . . . the children. . . ." The utility has been ordered to relocate the line at a cost that may exceed $40 million. In short, we have invested enough to produce a body of science that, in its current state, will support vigorous adversarial debate and rancor for years to come and are now truncating government research funding before producing enough science to resolve the question of risk.

Research can never demonstrate that a risk does not exist. It can establish probabilistic bounds on possible risks, and, if those bounds are sufficiently low, we should then say "enough." For this to happen two things are needed. First, government agencies need to explicitly consider the question of "stopping rules" before they embark on mission-oriented programs of risk research. As the research progresses they need to continue to refine those rules in the light of what has already been investigated and learned; what it is likely to cost to learn more; what the risks might be; and what kinds of findings are still needed before it makes sense to stop. Second, we need to evolve some common understanding between society, risk regulators, and the courts about how to establish acceptable probabilistic upper bounds on possible risks. Without these two developments, well-meaning government investments in risk-motivated applied research may sometimes do more harm than good.

—M. GRANGER MORGAN, Department of Engineering and Public Policy, Carnegie Mellon University, Pittsburgh, PA 15213

*See reviews in *Biological Effects of 60 Hz Power Transmission Lines* (Report of the Florida Electric and Magnetic Fields Science Advisory Commission to the Florida State Department of Environmental Resources, Tallahassee, FL, March 1985); M. G. Morgan, H. K. Florig, D. R. Lincoln, I. Nair, *IEEE Spectrum* **22**, 62 (February 1985); W. R. Adey, *Physiol. Rev.* **61**, 435 (1981).