The Power Line Controversy: Legal Responses to Potential Electromagnetic Field Health Hazards

I. INTRODUCTION

The boundaries of environmental law are again expanding. Concern over possible health hazards from electric power lines is increasing. In 1985 a Texas jury awarded a school district $25 million in punitive damages arising from the construction of power lines near two Houston schools.[1] The size of the award was primarily due to fear over possible health problems associated with power lines. While ultimately an appeals court overturned the award, subsequent suits have also sought large awards because of concern over electric and magnetic fields created by power lines.[2] In 1989, after a lengthy and expensive trial (over two million dollars was spent by the defense alone)[3] property owners in upstate New York lost a $63 million suit similar to the Texas action.[4] The New York case failed primarily due to the court finding that the scientific and medical evidence did not support as reasonable fears over electric and magnetic fields associated with power lines.[5]

Although there is no definitive evidence that power line electromagnetic fields pose health hazards, an increasing number of recent scientific, medical and epidemiologic studies support those fears as being reasonable. As a 1989 report by the Congressional Office of Technology Assessment put it, "There is now a very large volume of scientific findings. . . .which clearly establish that low frequency magnetic fields can interact with, and produce

1. Klein Independent School Dist. v. Houston Lighting and Power Co. (Tex. County Civ. Ct., 1985).

2. Houston Lighting and Power Co. v. Klein Independent School Dist., 739 S.W.2d. 508 (Tex. App. Houston [14th Dist.] 1987). While the $25 million damage award was found in error by the Court of Appeals, the utility eventually relocated the power lines away from the schools. *See id.* at 521.

3. *NY Judge Rejects Power Line "Cancerphobia" Argument*, 9, No. 5 MICROWAVE NEWS, 1, 5 (Sept./Oct., 1989).

4. Zappavigna v. State of New York and Power Authority of the State of New York, No. 74085, (N.Y. Ct. Cl. Sept. 29, 1989).

5. *Id.*

changes in, biological systems."[6] The report goes on to state that "implications of the interactions for public health remains unclear, but there are legitimate reasons for concern."[7]

Although the health threat is unclear, possible health hazards from power line electromagnetic fields is increasingly an issue raised in condemnation cases. These suits may increase even more due to extensive national media coverage during 1989 of electromagnetic fields and possible associated health hazards.[8] Courts, however, are split on the burdens that have to be met to provide compensation. Courts in twelve states and one federal jurisdiction only require that the fear of power line electromagnetic fields, reasonable or not, decreases property values. Courts in ten states require that the fear be a reasonable fear and that the fear decreases the value of the property. Three jurisdictions view electromagnetic power line fields as too remote and speculative to be considered.[9]

Concern over power line electromagnetic fields has also prompted regulatory and legislative action. Seven states have set standards for power line electric or magnetic fields,[10] at least three have passed statutes addressing the issue in some other way [11] and regulatory bodies in at least two states have held hearings on electromagnetic fields.[12] Municipalities have also acted,[13] and Congress has held five hearings on the subject or related issues.[14]

6. U.S. Congress, Office of Technology Assessment, *Biological Effects of Power Frequency Electric and Magnetic Fields - Background Paper*, OTA-BP-E-53 (Washington, D.C., U.S. Govt. Printing Office, May, 1989) 67 [hereinafter *Biological Effects*].

7. *See id.* at 75.

8. The primary cause for this recent coverage appears to be a three part article in THE NEW YORKER magazine by Paul Brodeur which ran in the late spring of 1989. Brodeur, *The Hazards of Electromagnetic Fields*, THE NEW YORKER, June 12, 1989 at 51, June 19, 1989 at 47, June 26, 1989 at 58. The article was based on a book by Brodeur called *Currents of Death: Power Lines, Computer Terminals and the Attempt to Cover Up Their Threat to Your Health* (1989). Subsequent to The New Yorker article, Newsweek, Time, The New York Times and other national publications covered the issue as well as national television. *See*, for instance: Cowley, *An Electromagnetic Storm*, NEWSWEEK, July 10, 1989 at 77. *See America Tunes In, But for How Long?* 9, No. 4, MICROWAVE NEWS, 15 (July/August, 1989).

9. Florida Power and Light Co. v. Jennings, 518 So.2d 895, 898 (Fla. 1987).

10. *Biological Effects, supra* note 6, at 73.

11. *See infra* notes 114 and 115 and accompanying text.

12. *See infra* note 112 and accompanying text.

13. *See infra* notes 117 and 118 accompanying text.

14. *Radiation Health and Safety: Hearings Before the Senate Comm. on Commerce, Science and Transportation*, 95th Cong. 1st Sess. (1977), *Research on Health Effects of Nonionizing Radiation: Hearings Before the Subcomm. on Natural Resources and Env't of the House Comm. on Science and Technology*, 96th Cong. 1st Sess. (1979), *Potential Health Effects of Video Display Terminals and*

What does the future hold for this embryonic field of law? This note argues that recent scientific knowledge of electromagnetic fields — while not definitively finding that such fields are a health hazard — has nonetheless reached a point where it supports the taking of prudent measures to protect the public health.

Part II of this note provides technical background information on electromagnetic fields. Part III analyzes case law standards required for recovery in power line condemnation cases when potential power line electromagnetic field health hazards are an issue. Part IV reviews key studies on possible health hazards associated with power line electromagnetic fields with an emphasis on studies supporting the belief that such fields may be dangerous. Part V surveys statutory and regulatory responses to the issue, and Part VI will conclude with a list of recommended actions.

II. Background on Electromagnetic Fields

In order to understand the legal and health consequences of electromagnetic fields, a basic understanding of what creates these fields and what constitutes electromagnetic radiation is needed. An electric current — electricity in motion — creates electric and magnetic fields. The interaction of electric and magnetic fields create an electromagnetic field.[15] So wherever there is electricity in motion — power transmission lines, distribution lines, appliances, wiring in homes and offices — there are electromagnetic fields. In this note reference to power lines is to high voltage transmission lines.

Electric and magnetic fields also occur naturally.[16] The earth's natural magnetic field, which varies in strength depending upon location, permits compasses to work.[17] Eels, sharks and pigeons can detect very weak electric fields and use them for navigational purposes.[18] Electromagnetic waves occur in front of cold fronts

Radio Frequency Heaters and Sealers: Hearings Before the Subcomm. on Investigation and Oversight of the House Comm. on Science and Technology, 97th Cong. 1st Sess. 28 (1981), *Health Effects of Transmission Lines: Oversight Hearings Before the Subcomm. on Water and Power Resources of the Comm. on Interior and Insular Affairs*, 100th Cong., 1st Sess. (1987), *Electric Power Lines: Health and Public Policy Implications: Hearings Before the Subcomm. on General Oversight and Investigations of the Comm. on Interior and Insular Affairs*, 101st Cong., 2nd Sess. (1990).

15. *Electromagnetic Field*, 6 McGraw-Hill Encyclopedia of Science and Technology 146 (1986).

16. *Biological Effects*, *supra* note 6 at 1.

17. *See id.* at 2.

18. *See id.* at 2.

or during lightning storms.[19] Human cell membranes have natural electric fields.[20]

Electromagnetic fields are a form of radiation. Historically more attention has been paid to ionizing radiation. Ionizing radiation is radiation that has enough energy to turn a neutral atom or molecule into a charged particle; in other words, to ionize it.[21] Examples of ionizing radiation include nuclear radiation and x-rays. Electromagnetic fields associated with power lines, however, are a form of nonionizing radiation. Nonionizing radiation does *not* have enough energy to ionize atoms.[22]

Ionizing radiation is at the high energy end of the electromagnetic spectrum. The electromagnetic spectrum measures energy using a scale based on frequency (cycles per second or hertz) and wavelength. At the lower end of the electromagnetic spectrum is nonionizing radiation. Electromagnetic fields created by power lines are at the very low end of the electromagnetic spectrum. Consequently they are called extremely low fields or ELF.

Electromagnetic fields can be measured in a number of different ways and by using a variety of different units.[23] An electric field is simply a description of the electric force that an electrically charged object — e.g. a power line — exerts on other nearby electric charges.[24] Electric fields are commonly measured in volt per meter (V/m). Measurement of magnetic fields is commonly in gauss, a measurement of magnetic flux density.[25] The following two charts provide an idea of exposure levels to electric and magnetic fields in a variety of environments. Note that a person standing on the edge of the right-of-way (row) of a high voltage transmission line is exposed to voltage frequently as high as 1,000 volts per meter. Using an electric blanket can expose a person to as strong an electric field as standing near the edge of a high voltage transmission line (between 100 and 1,000 V/m). The magnetic field charts show that standing near some household

19. Laquidara, *Litigating Nonionizing Radiation Injury Claims: Traditional Approaches to a Contempory Problem*, 10 B.C. ENVTL. L. REV. 965, 970 (1982-83).

20. *Biological Effects, supra* note 6, at 1.

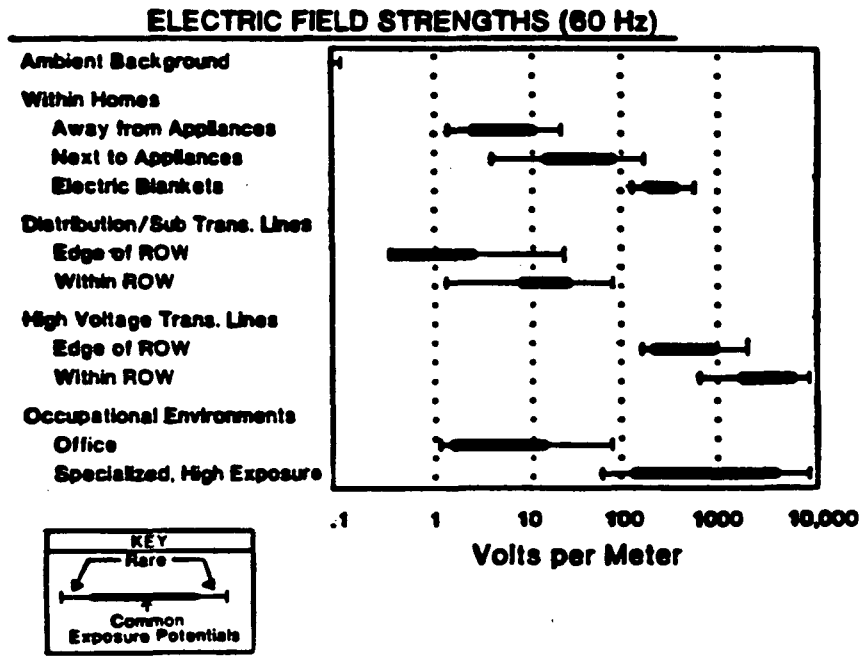
21. Massey, *The Challenge of Nonionizing Radiation: A Proposal for Legislation*, 1979 DUKE L.J. 105, 110.

22. *See id.* at 110.

23. *New York State Powerlines Project Scientific Advisory Panel Final Report, Biological Effects of Power Line Fields* 30-31 (1987) [hereinafter *Powerlines Project*].

24. *See id.* at 7.

25. *Biological Effects, supra* note 6 at 8.

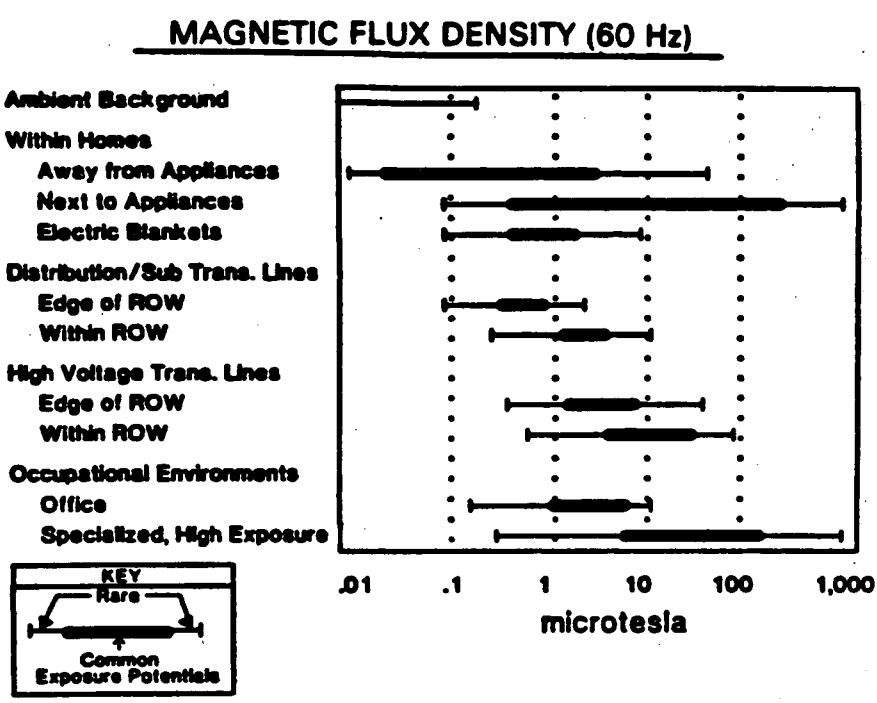


appliances subjects you to the same or stronger strength magnetic field occurring at the right of way of a high voltage transmission line. Keep in mind, however, that household appliances are usually on for only short periods of time; consequently exposure time is limited. In addition, exposure to electromagnetic fields from appliances is usually limited to portions of a person's body while exposure to power line electromagnetic fields is to the entire body. Electromagnetic fields from appliances also drop off very quickly, so being just a few feet away from an appliance usually places a person out of an appliance's electromagnetic field.

III. Case Law

Case law involving power line electromagnetic field health concerns is sparse. Most cases addressing power line health issues are property condemnation cases. There are few reported personal injury or environmental damage suits.[26] Causation, statute

26. On occasion electromagnetic field issues arise in suits concerning environmental impact statements. For instance, an action seeking environmental impact statements for certain military facilities using electromagnetic pulse simulators resulted in a military facility in Woodbridge, Virginia ceasing operation until an environmental impact statement on electromagnetic field issues could be completed. *U.S. Army to Prepare EMP EIS*, 9, No. 1, Microwave News, 3 (Jan./Feb. 1989).



of limitations, scientific uncertainty and expense [27] appear to be the main barriers to bringing such cases.[28] Another reason may be settlement of such suits. In a related area of concern, for instance, microwave suits have frequently been settled with stipulations that the details of the settlements are kept secret.[29] After a review of two personal injury suits, due to the sparsity of such suits, this note will focus on power line condemnation cases.

In 1987 a personal injury suit based on health problems allegedly caused by power lines was filed in the District Court of Harris County, Texas.[30] The suit was brought by Michael Allen Scott

27. A leading litigator in the field, H. Dixon Montague, who argued *Klein Independent School District* has explained that it is extremely expensive to bring a personal injury suit involving electromagnetic fields. The individual plaintiff might not have the funds necessary for expert testimony and other expenses while defendant utilities do tend to have adequate financial resources. The utilities, according to Montague, can put the legal expenses in their rate bases. Telephone interview with H. Dixon Montague, Partner, Vinson & Elkins, Houston, Texas (April 2, 1990).

28. Laquidara, *supra* note 18, at 978.

29. *RCA Pays $250,000 to Settle Yannon Microwave Injury Suit*, 9, No. 3, MICROWAVE NEWS, 1 (May/June 1989).

30. Plaintiff's Original Petition, *Michael Allen Scott v. Houston Lighting and Power Co.*, District Court of Harris County, Texas, 189th Judicial District. (No. 87-58967).

who lived near a 345 kV transmission line operated by the Houston Lighting and Power Company. At age twenty-six Mr. Scott developed a fatal brain tumor. He subsequently alleged that the electric or magnetic fields created by the power line either caused or worsened the tumor.

Mr. Scott brought his suit on both negligence and strict liability arguments. The plaintiff's original petition argues that his health problem is one the defendant utility knew, or should have known, "could be proximately caused, and/or aggravated, by exposure to the electromagnetic and magnetic fields from ultrahazardous high voltage lines."[31] The petition goes on to state that transmission of electricity at levels such as 345 kV is an ultrahazardous activity for which the defendant should be strictly liable. Scott also argues that the utilities knew since 1975 of the health hazards associated with electromagnetic fields, yet did not warn the public, including the plaintiff, of these hazards and is therefore negligent.[32]

A second, related case has been brought by Scott's sister charging that the utility violated the Texas Real Estate Fraud Act.[33] She argues that the utility misrepresented and failed to state all the material facts concerning the alleged safety hazards associated with high power transmission lines.[34] Neither case has yet gone to trial.[35]

In contrast to the scarcity of reported personal injury suits, there are numerous condemnation cases in which power line electromagnetic fields are an issue. These cases usually concern severance damages, that is, compensation for the diminished value of property remaining after a partial condemnation of one's land. Power line condemnation cases involving electromagnetic health issues have developed into three divergent streams of judicial opinion. The most liberal view, held by a majority of courts, is epitomized by *San Diego Gas and Electric v. Daley*.[36] *Daley* supports the theory that public fear of power line electromagnetic fields is admissable to show such fear might depress property values even

31. *See id.* at 6.

32. *See id.* at 2.

33. Plaintiff's Original Petition, *Beverly Scott Rainwater v. Houston Lighting and Power Co.*, Dist. Ct. of Harris County, Texas, 234th Judicial District, (No. 87-58968).

34. *See id.* at 5.

35. Mr. Scott died in 1989.

36. 253 Cal. Rptr. 144, (Ct. App. 4 Dist. 1988).

though there is no conclusive proof of these hazards. The slightly stricter, intermediate position is represented by the recent New York case *Zappavigna v. State of New York and Power Authority of the State of New York*.[37] *Zappavigna* required that there must be reasonable grounds for the potential purchaser's fears and a proven drop in market value. The strictest, minority view is that fears over power lines are too speculative and cannot be considered in awarding compensation. The recent judicial trend has been to adopt the most liberal, majority view.

The case which most clearly lays out the three divergent views is *Willsey v. Kansas City Power and Light Corp*.[38] The court articulates the minority, intermediate and majority positions, as follows:

> The three views may thus be summarized as follows: The first holds that fear of danger from power lines is necessarily based on pure speculation by an ignorant public and can never be an element of damages even if it affects the market value of the land. The second holds that, while conjectural damages are noncompensable, if the fear is *shown to be reasonable* (or at least not wholly unreasonable) and in fact affects market value, the loss *is* compensable. The third holds that the dangerous nature of power lines is a fact proven by common experience, and that the impact of public fear of such danger on market value may be shown and compensated *without independent proof* of the reasonableness of that fear.[39]

Currently at least twelve states (Arkansas, California, Florida, Indiana, Iowa, Louisiana, North Carolina, Ohio, Oklahoma, South Dakota, Virgina and Washington) and the U.S. Court of Appeals, 6th Circuit, with its numerous Tennessee Valley Authority cases, follow the majority position. Ten states follow the intermediate position (Connecticut, Georgia, Kansas, Kentucky, Missouri, Nebraska, New Jersey, Tennessee, Texas and Utah). Only three states are in the minority position (Alabama, Illinois and West Virginia).[40] This note will first discuss the majority view, then the intermediate position and finally the minority view.

The majority view is clearly articulated in *San Diego Gas and Electric v. Daley*.[41] The case is an appeal from a condemnation award for severance damages arising from a power line easement. In

37. No. 74085, slip op., (N.Y. Ct. Cl., Sept. 29, 1989).

38. 6 Kan. App. 2d 599, 631 P.2d. 268 (1981).

39. *See id.* at 273-74 (emphasis in original).

40. Florida Power and Light Co. v. Jennings, 518 So. 2d 895, 898 (Fla. 1987). Also see Willsey v. Kansas City Power and Light Co. 631 P.2d. 268, 273.

41. 253 Cal. Rptr. 144.

the original action the utility moved to prevent anticipated expert testimony on alleged power line electromagnetic hazards as well as testimony on the effect the public's fear might have on property values. The trial court did not permit the testimony on potential harmful health effects finding that the reasonableness of buyer fear was irrelevant.[42] The court did, however, allow testimony showing that the public's fear of electromagnetic fields would diminish property values.[43] The Court of Appeals upheld the lower court decision.

> The trial court here was correct in its analysis and determination that the truth or lack of truth in whether electromagnetic projections caused a health hazard to humans or animals was immaterial. Rather the question was whether the fear of the danger existed and would affect market value.[44]

Another recent case in a majority jurisdiction, *Florida Power and Light Co. v. S. B. Jennings* [45] reversed an earlier Florida decision (*Casey v. Florida Power Co.*) [46] that followed the minority position. *Jennings* therefore moved the Florida courts into the majority, liberal position. The court held in *Jennings* that "all evidence relevant to the issue of full compensation is admissable in eminent domain proceedings. The public's fear as a factor which may be relevant to the issue of just compensation may be utilized as a basis for an expert's valuation opinion regardless of whether this fear is objectively reasonable."[47] The court explains that whether or not electromagnetic fields created by power lines are a health hazard is not the issue, rather the issue is whether the public's fear of such power line health hazards affect the value of severed land. The court noted "that fair market value (comparing pre with post-condemnation values) is merely a tool in determining full compensation, and that 'all facts and circumstances which bear a reasonable relationship to the loss' must be taken into account."[48]

In contrast to the liberal, majority position typified by *San Diego* and *Jennings*, the previously cited *Willsey v. Kansas City Power and*

42. *See id.* at 146.
43. *See id.* at 151.
44. *See id.* at 152.
45. 518 So. 2d 895 (Fla. 1987).
46. Casey v. Florida Power Corp., 157 So. 2d. 168 (Fla.2d DCA 1963).
47. 518 So. 2d 895 (Fla. 1987).
48. *Id.* at 897 *citing* Jacksonville Expressway Authority v. Henry G. Du Pree Co., 108 So. 2nd 289, 291 (Fla. 1958).

Light Co.[49] represents the intermediate position. *Willsey* is an appeal by a utility company from an award to property owners in a condemnation proceeding. The utility had condemned an easement in order to build a 161,000 volt power line. While the Kansas Court of Appeals in *Willsey* favored the majority rule it found it necessary to go only as far as the intermediate rule.[50] The court states that "there can be no quarrel with the proposition that 'mere fears' of injury cannot be compensated. . . .[R]emote, speculative and conjectural damages are not to be considered. . . . Logic and fairness, however, dictate that any loss of market value proven with a reasonable degree of probability should be compensable, regardless of its source."[51]

How does a court determine if a fear is reasonable and can therefore be considered in awarding damages? The court in *Willsey* used a three part test the Texas Civil Appellate Court used in *Heddin v. Delhi Gas Pipeline Co.*[52] That case concerned a condemnation action for construction of a gas pipeline. The test the court used in *Heddin* was:

> Fear in the minds of the buying public on the date of taking is relevant to the proof of damages when the following elements appear: 1. That there is a basis in reason or experience for the fear; 2. That such fear enters into the calculations of persons who deal in the buying and selling of similar property; and 3. Depreciation of market value because of the existence of such fear. . . .
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> . . . .
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> To establish that there is a basis in reason or experience for the fear, it is incumbent upon the landowners to show either an *actual danger* forming the basis of such fear or that the fear is reasonable, whether or not based upon actual experience. Reduction in market value due to fear of an unfounded danger is not recoverable. This rule is designed to exclude consideration only of those few situations in which the danger underlying the fear finds its basis in neither reason nor experience but is predicated rather on fancy, delusion or imagination.[53]

The crux of this test is that the fear must be based on an actual danger or that the fear must be reasonable in order to be considered in awarding damages. The fear is not considered only in the

49. 6 Kan. App. 2d 599, 631 P.2d 268 (1981).
50. *See id.* at 278.
51. *See id.* at 277-78.
52. 522 S.W.2d 886, 888 (Tex. 1975).
53. *See id.* at 888 (emphasis in original).

extreme case where it is unsubstantiated and arises from "fancy, delusion or imagination."[54] The court allowed as proof of the danger specific cases where similar pipelines in similar circumstances ruptured. The *Willsey* court states that "reasonableness is a question of fact."[55] In applying the *Heddin* test the court in *Willsey* found that the fear in its case of power lines was "eminently reasonable"[56] and therefore admitted the fear as a proper consideration in determining the condemnation award.

New York State courts also follow the intermediate approach. The New York Court of Claims decision in *Zappavigna v. State of New York and Power Authority of the State of New York* is the most recent (September, 1989) major decision concerning power line electromagnetic fields.[57] *Zappavigna* was the first of sixty-three claims for damages that were joined for trial. The actions were joined for the efficiency of hearing expert testimony on the issue of "direct and consequential damages caused by the alleged harmful effects of electromagnetic fields emanating from power lines."[58] In other words, the court had to consider the impact of fear of alleged power line electromagnetic field dangers on property values when determining the amount of compensation. Initially the claimant made an indirect appropriation argument.[59] The argument was that due to the extent of electromagnetic fields the utility actually condemned *de facto* a much wider swarth of land than it took officially. The claimant later modified his pleading to the following:

> The claimant does not seek to get a determination by this Court whether there are health risks or whether that there are not. Claimant claims that based upon the present state of science and the attendant publicity emanating through the nation that buyer's have 'fear' of health risks associated with these high voltage power lines.
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> . . . The uncertainty, as evidenced by the controversy of the witnesses presented, formed a reasonable basis upon which prudent, knowledgable, well-informed buyers in the marketplace could justifiably base a fear as evidence [sic] by the reluc-

54. *See id.* at 888.

55. *Willsey v. Kansas City Power and Light Co.*, 631 P.2d 268, 279 (1981).

56. 631 P.2d at 279.

57. Zappavigna v. State of New York and Power Authority of the State of New York, No. 74085 (N.Y.Ct. Cl. Sept. 29, 1989).

58. *See id.* at 2.

59. *See id.* at 8.

> tance to buy or a willingness to buy only at a substantially reduced price.[60]

The claimant wanted increased compensation due to potential purchasers' reasonable fears over power lines. These reasonable fears decreased the value of the claimant's land, according to the claimant. The claimant in *Zappavigna* argued that the court should follow the majority position represented in *San Diego.* The difference between the majority position and the intermediate position as seen in *Zappavigna* is, as Judge McCabe in *Zappavigna* put it, "the California court did not require, as does New York State, that there be proof of the existence of reasonable grounds for the fear."[61]

Judge McCabe, however, decided not to follow *San Diego* since in that case the court awarded damages "without proof from the market place."[62] Instead Judge McCabe followed an earlier case, *Miller v. State of New York,* in finding against the plaintiff landowner.[63] In *Miller,* decided in 1982, the court found against the claimant's argument that "unfavorable statements and reports concerning health hazards had the effect of decreasing the market value of claimant's land. . . ."[64] The court explained that "some vague and unfounded fear cannot form the basis for the recovery of consequential damage, as any such damage would be speculative and capricious in nature. Only a reluctance to purchase predicated on the reasonable apprehension of a potential purchaser should be considered. . . ."[65]

In following *Miller,* the court in *Zappavinga* held that the claimant had two burdens of proof to meet:

> 1) he must prove that a potential purchaser has reasonable grounds for apprehension that power lines cause health problems. Claimant has the burden of proving this by a preponderance of the credible scientific evidence; and, 2) that this reasonable apprehension has affected the purchaser's willingness to pay the fair market value of the property, as evidenced by proof from the real estate market, or, as stated in *Miller,* . . . "based on the actual pricing experience shown from before and

60. *See id.* at 9 (Court decision quoting modified complaint).

61. *See id.* at 11.

62. *See id.* at 12.

63. Miller v. State of New York, 117 Misc.2d. 444 (Ct.Cl. 1982).

64. *See id.* at 446.

65. *See id.* at 446-47.

after sales." Claimant has the burden of proof by a preponderance of the credible real estate evidence.[66]

Claimant Zappavingna tried to meet his first burden of proof — that the fears of the potential purchasers are reasonable — by expert scientific testimony. One claimant witness testified to the effect that "epidemiological studies are limited because they are incapable of establishing causality, but do show that there is a *possible* link between exposure and disease."[67] A second claimant witness testified that "there is a real problem to human health associated with exposure to electric and magnetic fields at power line frequency. . . .I don't know how big this problem is. I don't know if it's a big problem, I don't know if it's a small problem."[68] Dr. Lennart Tomenius of Sweden also testified that his studies and studies done by Nancy Wertheimer "showed a relationship between residences proximate to magnetic fields and the occupant's cancer."[69] Countering these claimant's witnesses were a number of defense witnesses. One tesitifed that "after consideration of genetics, hematology, immunology and epidemiology taken as a whole, there is no causal relationship between exposure to power frequency electric and magnetic fields and childhood cancer."[70] Another testified that "there was no reasonable scientific basis for people to fear transmission lines."[71]

After reviewing the scientific testimony the court concluded that the claimant failed to meet his burden of "preponderating in the evidence on the issue that there is a reasonable basis for any fear that power lines cause health problems."[72] All the claimant did, according to Judge McCabe, was to show that scientists are concerned about potential problems associated with power line electromagnetic fields.[73]

The court also found that the claimant failed to meet his second burden of proof - that the fear of power lines decreased the market value of property near the power lines. [74] Because the claim-

66. Zappavigna v. State of New York and Power Authority of the State of New York, No. 74085, slip op. at 10 (N.Y. Ct. Cl. Sept. 29, 1989).
67. *See id.* at 14 (emphasis in original).
68. *See id.* at 17.
69. *See id.* at 19.
70. *See id.* at 16.
71. *See id.* at 21.
72. *See id.* at 25.
73. *See id.* at 25.
74. *See id.* at 31.

ant failed both of his burdens of proof, the court concluded that it could not "make an award for damages caused by 'cancerphobia.' "[75]

In late 1989 the New York Power Authority appealed the award in *Zappavigna*. Three days later a cross appeal was filed on behalf of the property owners. The Power Authority is apparently appealing the entire decision except for the electromagnetic health issue. The property owners are cross appealing only on the health issue. An attorney for the property owners has stated that the court "erred on its burden of proof. We shouldn't have to prove [EMFs] cause cancer, just that there is sufficient cause for concern."[76]

An example of the minority view is *Central Illinois Light Co. v. Nierstheimer*.[77] In *Nierstheimer* a utility condemned the appellee's farmland for a power line easement. The court followed *Illinois Power and Light Co. v. Talbott*.[78] In that case a witness' testimony apparently considered possible damage from the electricity carried by the power lines (e.g. increased risk of fire or lightning). In reviewing the *Talbott* case, the court in *Nierstheimer* explained that:

> In order to recover damage for land not taken there must be evidence of a direct physical disturbance of a property right. . . .[W]e also held (in *Talbott*) that the imagined source of danger considered by the property owner's witnesses were so remote and speculative and uncertain as to afford no basis for the allowance of damages.[79]

Similar logic prevailed in a subsequent case involving a gas pipeline, which the court in *Nierstheimer* also cited:

> We held that mere fear of the presence of an instrumentality such as a pipeline does not rest upon a substantial basis and is not a proper element to be considered in determining depreciation of the land not taken.[80]

Courts adhering to the minority position therefore require plaintiffs to pass a very high standard — the court in *Nierstheimer* required a direct physical disturbance — in order to receive compensation due to the construction of power lines.

75. *Id.*

76. *Marcy-South "Cancerphobia" Decision Appealed* 10, No. 1 Microwave News at 3 (Jan./Feb. 1990).

77. 26 Ill.2d. 136, 185 N.E.2nd 841.

78. 321 Ill. 538, 152 N.E. 486.

79. *Nierstheimer*, 26 Ill. 2d at 140.

80. *See id.* at 141.

This review of case law standards regarding power line electromagnetic fields has shown that most jurisdictions (courts following both the majority and intermediate standards) allow the public's fear of power line electromagnetic fields to be considered in awarding compensation. In majority jurisdictions the only requirement is that the fear result in a decrease in property values. For courts following the intermediate position the fear must be shown to be reasonable, as well as reducing property values. Therefore evidence that power line electromagnetic fields may be dangerous is crucial.[81]

The plaintiff's interests determine whether it is advantageous for a case to be heard in a jurisdication following the majority or intermediate standard. A plaintiff who is a property owner simply trying to get compensation for decreased property values is better off litigating in a jurisdication following the majority standard. If, however, the plaintiff's interests are broader than specific compensation questions and concern public health issues, then courts following the intermediate position are preferable. For it is only in courts following the intermediate position that evidence of potential electromagnetic field health hazards will be admitted. In courts following the majority view, the cause of the drop in property values is irrelevant, so no testimony is required on the possible dangers of power line electromagnetic fields. For plaintiffs in personal injury suits, property owners in condemnation cases and plaintiffs concerned with public health issues to prevail in jurisdictions following the intermediate standard, the primary hurdle is whether modern scientific evidence supports finding electromagnetic fields dangerous. This question will be addressed in the next part of this note.

IV. Medical and Scientific Studies

Since 1972 studies have indicated that electric fields may pose a human health hazard. One of the first studies arose from reported health problems of train workers in Soviet electric train

81. That the fear be reasonable is the standard also used for "cancerphobia" cases arising from exposure to toxic chemicals. "In general, recovery for emotional distress for fear of disease may be had only when the plaintiff has demonstrated a specific fear of a particular disease and that fear is "reasonable." Maskin, *Cancerphobia: An Emerging Theory of Compensable Damages*, 31, No. 5 J. Of Occupational Medicine 427, 429 (May, 1989).

yards.[82] The first study to have a significant impact, however, was not until 1979 when an epidemiologic study in Denver, Colorado by Nancy Wertheimer and Ed Leeper showed a correlation between childhood leukemia and distribution line transformers.[83] That study, conducted primarily by Wertheimer on her own time and with her own funds, showed a doubling of childhood cancer rates in homes near distribution line transformers.[84] This study has been repeatedly criticized for its methodology; due to budget constraints it was not carried out as a double blind study and was therefore susceptible to the researcher's biases.[85] The study was also criticized for not adequately ruling out other possible external factors such as cigarette smoke or socioeconomic factors.[86] A second study published in 1986 by Swedish researcher Dr. Lennart Tomenius also found a correlation between childhood cancer and proximity to power lines, thereby lending support to the Wertheimer/Leeper study.[87]

Both of these epidemiologic studies continue to be debated in the scientific community. Epidemiologic studies are limited in their scientific and legal impact. While epidemiologic research can point to the possible existence of a problem, the studies do not necessarily rule out other sources of the problem and don't show the exact medical causative process. Consequently, laboratory and direct scientific proof of the connection between electromagnetic fields and health problems are needed.

Such studies have been undertaken. For instance, investigations have been performed concerning cellular effects of electromagnetic fields, genetic studies and *in vitro* studies (or in glass, i.e. in test tubes). The results of one study indicated that electromagnetic fields can affect calcium flow from cell membranes in brain

82. Korobkova, *Influence of the Electric Field in 500 and 750 kV Switchyards on Maintenance Staff and Means for its Protections*, Technical Report 23-06, CIGRE paper (1972).

83. *Biological Effects*, *supra* note 6, at 58.

84. Wertheimer & Leeper, *Electrical Wiring Configurations and Childhood Cancer*, 109 AM. J. OF EPIDEMIOLOGY 273, 283 (1979).

85. *Powerlines Project*, *supra* note 23, at 75. A double blind study is one in which the person evaluating the results does not know which participants (or in this case, which houses) were controls and which were not. To check on the study's reliability, Wertheimer and Leeper did have a randomly chosen sample of addresses analyzed in the study rechecked blindly by an assistant. The results of this sample basically confirmed the results of the larger study. *See supra* note 81 at 282-83.

86. *Powerlines Project*, *supra* note 23 at 76.

87. Tomenius *50-Hz Electromagnetic Environments and the Incidence of Childhood Tumors in Stockholm County*, 7 BIOELECTROMAGNETICS 191-207 (1986).

tissue.[88] S. M. Bawin published research in the proceedings of the National Academy of Sciences that showed brains of recently killed chicks had lower levels of calcium flow when exposed to extremely low frequency fields. Calcium flow is important because it helps regulate heartbeats, egg maturation and ovulation and cell division.[89] Decreased calcium flow, however, only seemed to occur at certain frequency and amplitude "windows" of 10 V/m and 6 Hz or 16 Hz.[90]

Other studies indicated that exposure to extremely low frequency fields alter DNA synthesis rates and RNA transmission patterns.[91] Since DNA and RNA are crucial genetic factors these changes might affect subsequent generations.

Research by R. A. Luben on extremely low frequency field influences on hormones has also indicated effects on endocrine tissue at certain "windows."[92] Possible depressed immune response effects from exposure to electric fields have been reported by Lyle. The ability of cells to attack cancer was inhibited after exposure to low level electric fields.[93] The immune system is significant because it combats viruses and toxics. The increased cancer rates associated with power lines might be due to immune system repression by electric fields associated with such lines.[94] One theory has been that electromagnetic fields do not cause cancer; rather the fields either promote cancer or reduce the body's ability to resist cancer.[95] Note that several of the studies have indi-

88. Bawin, *Sensitivity Binding in Cerebral Tissue to Weak Environmental Electric Fields Oscillating at Low Frequency* 73, 6 Proceedings of the National Academy of Sciences 1999-2003, June, 1976. Cited in *Biological Effects*, *supra* note 6 at 26.

89. *Biological Effects*, *supra* note 6 at 25-26.

90. *See id* at 23.

91. Liboff, *Time Varying Magnetic Fields: Effect on DNA Synthesis*, SCIENCE, Feb. 24, 1984, at 818.

92. Luben, *Effects of Electromagnetic Stimuli in Bone and Bone Cells in Vitro: Inhibition of Responses to Parathyroid Hormone by Low-energy, Low-frequency Fields*, Proceedings of the National Academy of Sciences 79 4180-84 (1982).

93. Lyle, *Proliferation of Myeloid Leukemia Cell Lines and Allogenic Toxicity Presence of 60 Hz Fields, Also see Biological Effects, supra* note 6 at 31.

94. *Biological Effects, supra* note 6 at 31.

95. In its general conclusions about extremely low frequency (ELF) electromagnetic fields, such as the ones created by power lines, the Congressional Office of Technology Assessment report summarizes that among other possible implications;

> ELF fields have been shown to increase ornithinedecaroxylase (ODC) activity. All known cancer promoters stimulate ODC. However, the converse is not true. Many agents that promote ODC activity are not cancer promoters.
>
> Alterations in protein synthesis, in immunological and hormone status, and in metabolic competence via circadian shifts can all contribute to the progress of initiated

cated that biological effects seem to occur only at certain levels or frequencies. In some cases biologic changes seem to occur only when a number of conditions are met. This characteristic of electromagnetic fields should be considered when promulgating electromagnetic field exposure regulations. A simple threshold standard may not be adequate.

Most publicity over possible power line hazards has concerned a perceived cancer threat. Research, however, has shown possible dangers to brain chemistry, genetics, hormones and immune systems. While the studies discussed here have all shown some biologic changes, and possible health hazards, numerous other studies have shown no effect.[96] Presently there is no conclusive proof that power line electromagnetic fields are dangerous.[97] The strongest evidence that electromagnetic fields pose a health hazard are the epidemiologic studies. Skeptics of the theory that electromagnetic fields are hazardous point out that epidemiologic studies do not show causation. However, as one researcher on power line electromagnetic fields observed:

> The absence of a demonstrated carcinogenic effect of magnetic fields in the laboratory clearly weakens the inferences that can be made based on the epidemiologic studies. Nonetheless, the historical examples of epidemiologic discoveries of such biologically "implausible" carcinogens as tobacco smoke, benzene and arsenic should be noted, all of which were ultimately followed (rather than preceded) by laboratory confirmation.[98]

Despite the lack of a clearly demonstrated causal connection between electromagnetic fields and health problems, this review of scientific and medical literature shows that fear of power line electromagnetic fields is reasonable.[99]

cancer. To the extent that ELF fields play a role in those, they might have an effect on tumor growth or indeed tumor inhibition. The increase in ODC activity noted above is indicative of growth enhancement rather than inhibition.

Pineal melatonin depression has been associated with cancer growth, and administration of melatonin has been found to slow the growth of cancer. ELF fields depress pineal melatonin levels in animals. *See Biological Effects, supra* note 6 at 67-68.

96. *See id.* at 28, 31, 33.

97. *Biological Effects supra* note 6 at 3, 67.

98. Savitz, *Case-Control Study of Childhood Cancer and Exposure to 60-HZ Magnetic Fields*, 128, No. 1 AM. J. OF EPIDEMIOLOGY 21, 37 (1988).

99. As the Office of Technology Assessment report states: "The emerging evidence no longer allows one to catagorically assert that there are no risks." *Biological Effects, see supra* note 6 at 3.

Research on health effects of powerline electromagnetic fields was significantly boosted as a result of an opinion issued by the New York Public Service Commission in 1978.[100] The opinion approved operation of two 765 kv power lines as part of the Massena-Moses power line project.[101] The Massena-Moses transmission line brings Canadian hydropower through upstate New York for eventual use in the New York City metropolitan area. The opinion required a $5 million research project to investigate possible health risks associated with electromagnetic fields near power lines. This research and literature review program — called the Powerlines Project — was funded by the New York State Power Authority and various utilities.[102] The Powerline Project was very extensive and interdisciplinary in nature. Experts in the areas of anatomy, physics, biochemistry, pharmacy, genetics, psychology, neurology, epidemiology, electrical engineering and bioengineering were involved.[103] While overall the conclusions of the experts involved with the project were mixed, the report's executive summary concluded by stating:

> In conclusion, results of the New York funded projects document biological effects of electric and magnetic fields in several systems. The variety of effects of magnetic fields have not been previously appreciated. Several areas of potential concern for public health have been identified, but more research must be done before final conclusions can be drawn. Of particular concern is the demonstration of possible association of residential magnetic fields with incidence of certain childhood cancers. . . .The variety of behavioral and nervous system effects may not constitute a major hazard because most appear to be reversible, but they may impact temporarily on human function.[104]

One key study conducted with funding from the New York State Powerlines Project was undertaken by David Savitz.[105] This $355,905 study, "Childhood Cancer and Electromagnetic Field Exposure," confirmed the findings of the earlier Wertheimer/Leeper and Tomenius research.[106] The Savitz study, however, was methodologically more strict than Wertheimer's work

100. Public Service Opinion (No.78-13, June 19, 1978), reported in 18 NY PSC 665.
101. *See id.* at 708.
102. *Powerlines Project, see supra* note 23 at 18.
103. *See id.* at 12.
104. *See id.* at 10.
105. *See id.* at 86.
106. *See id.* at 22 and 86.

and considered external factors such as socioecomonic status, smoking and x-rays.[107] The Savitz study found that the incidence of childhood cancer was twice as high for children with increased exposure to magnetic fields.[108] As a result of the Savitz work, the final Powerlines Project report estimated that 10% to 15% of all childhood cancers could be attributed to magnetic fields.[109]

The United States is not the only country in which research is being conducted. As already mentioned, studies have been completed in the Soviet Union and Sweden, and research programs are funded in England, West Germany, Canada, Japan, Italy, France, Finland and Norway.[110]

This review of epidemiologic and medical studies over the past several years shows that fear of electromagnetic fields created by power lines should be considered reasonable. At a minimum, biologic effects in animals are documented from some of the laboratory studies. The epidemiologic studies, however, especially the scientifically strict Savitz work, show potential for significant health concerns. Depending on the factual circumstances of the case, there is strong support for courts following the intermediate position requiring that fear of power line electromagnetic fields be reasonable, to find such fears are reasonable.[111] If a drop in the value of property not condemned is also present the property owners should receive compensation for the additional decrease in value.

V. STATUTORY AND REGULATORY ACTIONS

States and municipalities are increasingly taking actions to deal with the growing concern over power line electromagnetic fields. These actions tend to fall into three catagories: holding hearings, allocating or requiring funds for further research, and issuing electric or magnetic field limitations for power line right-of-ways.

The Maryland Public Service Commission and the Public Service Commission of Wisconsin have both held hearings recently

107. Savitz, *supra* note 95 at 25.

108. *Powerlines Project*, *see supra* note 23, at 85.

109. *See id.* at 85.

110. *Biological Effects*, *see supra* note 6 at 85.

111. Concerning personal injury cases, as an experienced litigator in the electromagnetic field area stated, "We are now at the cutting edge of health effects of electromagnetic field litigation. The scientific evidence is quickly mounting and the stage is set for substantial justification for a plaintiff's case to support a personal injury award." Telephone interview with H. Dixon Montague, Vinson and Elkins, Houston, Texas (April 2, 1990).

on health effects of power line electromagnetic fields and possible ways to limit them.[112] The Colorado Public Utilities Commission is planning to initiate a prudent avoidance strategy which will consist of inexpensive steps to minimize exposure to power line electromagnetic fields.[113] In 1988 California enacted a law that requires utilities to spend $2 million over two years on research into electromagnetic fields.[114] As already discussed, New York State implemented its $5 million Powerline Project. Washington State and Virgina require an annual report reviewing scientific and medical studies concerning possible health effects of power lines.[115] New Jersey legislation, which would require utilities to review environmental and public health issues prior to constructing additional power lines, is under consideration.[116] The Austin, Texas City Council has passed a resolution expressing concern over transmission line health effects.[117] The Seattle City Council ordered a review of scientific literature concerning health effects of power line electromagnetic fields.[118] One innovative action was taken by the California State Department of Education. The Department adopted a school siting policy that sets limits for how close a new school can be to power lines.[119]

112. *Power Line Talk*, 8, No. 5 MICROWAVE NEWS 5, 6 (Sept./Oct. 1988).

113. *Colorado PUC Adopts "Prudent Avoidance" Strategy*, 9, No. 6 MICROWAVE NEWS 6 (Nov./Dec. 1989).

114. *C.A. EMF Health Effects Bill Signed into Law*, 8, No. 5 MICROWAVE NEWS 7 (Sept./Oct. 1988).

115. *Washington State ELF Literature Review Issued*, 10, No. 1 MICROWAVE NEWS 5 (Jan./Feb., 1990). *See also*: *Virginia Annual Report Issued*, 9, No. 2 MICROWAVE NEWS 8 (March/April 1989).

116. *Around the United States*, 9, No. 4 MICROWAVE NEWS 9 (May/June 1989).

117. *Around the United States*, 9, No. 3 MICROWAVE NEWS 9 (May/June 1989).

118. *Sheppard to Seattle Light: Consider Epidemiological Data*, 9 No. 1 MICROWAVE NEWS 7, 8 (Jan./Feb. 1989). This literature review, entitled Update on the Scientific Literature Concerning Health Effects of 60-Hz Electric and Magnetic Fields of Power Transmission and Distribution Facilities, was released in September, 1988 as a result of Seattle City Council Resolution 27741.

119. School Site Selection and Approval Guide, California State Department of Education, 1989, at 4-5 (1989). The relevant passage is as follows:

> Little research exists on the effects of electromagnetic fields on human beings. Although a link between exposure to electromagnetic fields and adverse health effects has been discovered, the statistical correlation linking exposure and adverse effects are weak, and no scientific consensus supporting such findings exists. Nevertheless, school districts should take a conservative approach when reviewing sites situated near transmission line easements.
>
> The School Facilities Planning Division has established the following limits for locating school sites near high voltage power transmission line easements. . . .
>
> 1. 100 feet from edge of easement for 100-110 kv line

Seven states have issued regulations that set standards for electric fields at the edge of power line right-of-ways.[120] Florida has not only set an electric standard but also the nation's first magnetic field standard. This standard is now being appealed.

State	Field limit
Montana	1 kV/m at edge of RoW in residential areas
Minnesota	8 kV/m maximum in RoW
New Jersey	3 kV/m at edge of RoW
New York	1.6 kV/m at edge of RoW
North Dakota	9 kV/m maximum in RoW
Oregon	9 kV/m maximum in RoW
Florida	10 kV/m maximum for 500 kV lines in RoW
	2 kV/m maximum for 500 kV line at edge of RoW
	8 kV/m maximum for 230 kV smaller lines in RoW
	2 kV/m maximum for 230 kV and smaller lines at edge of RoW
	200 mG for 500 kV lines at edge of RoW
	250 mG for double circuit 500 kV lines at edge of RoW
	150 mG for 230 kV and smaller lines at edge of RoW

These electric and magnetic field standards are not health-based. Rather, they are in some cases technological achievable standards or simply codification of existing levels as is the case in New York State.[121] These standards do not necessarily protect the public. As the earlier section on medical and scientific studies discussed, some studies have shown variations in when possible health effects occur. Frequency and intensity "windows" seem to exist in which biological effects occur.[122] These windows do not appear to be addressed by the standards.

Electromagnetic field concerns are increasingly surfacing in different proceedings. The issue is raised not only in court cases and in standards and regulations, but also in licensing proceedings for transmission lines or other utility facilities and regulatory rulemaking actions in either formal or informal proceedings.[123] Promulgation of electromagnetic standards or regulations can substantially affect future court cases. For example, as a practicing litigator urged in a paper presented at the International Utility Symposium on Health Effects of Electric and Magnetic Fields:

2. 150 feet from edge of easement for 220-230 kv line

3. 250 feet from edge of easement for 345 kv line.

120. *Biological Effects*, *see supra* note 6, at 73.

121. *Florida Adopts First U.S. Power Line Magnetic Field Limit*, 9 No. 2 MICROWAVE NEWS 1 (March/April, 1989).

122. *Biological Effects*, *see supra* note 6, at 20.

123. Alvarez, C., *The EMF Issue: The Florida Regulatory And Legal Experience*, Technical Report, Proceedings of the International Utility Symposium, Sept. 16-19, Toronto, Canada (1986) Unpublished paper.

> *Do* attempt to get a state regulatory agency to have jurisdiction over the issue and establish appropriate guidelines. If done sufficiently in advance of controversy, the issue can be resolved at the regulatory stage free of the emotionalism which usually follows the issue. *Do attempt to preempt local governments from dealing with the EMF (electromagnetic field) issue once a state regulatory format is established.*[124]

Promulgation of standards, therefore, can be used in an attempt to preempt court cases.[125] Courts will not, however, automatically defer to existing regulations. Recently, in Florida, a school board was judicially ordered to keep children out of a school yard because of the presence of power lines. The judge in that case dismissed the regulatory preemption argument. "The court rejects defendant's argument that the state somehow preempted the safety field when it adopted certain regulations concerning fields at the edge of powerline right-of-ways. We reject the notion that the adoption of such a regulation is an imprimatur authorizing the building of schools on the edge of such right-of-ways."[126]

Statutory and regulatory actions are occurring on the state and local levels, not on the federal level. Overall, the statutory and regulatory measures are reasonable in light of the changing scientific knowledge on electromagnetic fields. As a result of recent scientific and medical studies and reports more state and local statutory and regulatory actions can be expected.

VI. Recommendations

While medical and scientific research is providing additional information on potential health hazards from power line electromagnetic fields, much uncertainty remains. The recent media coverage of the issue has been useful in raising the public's awareness of the issue. The increased public knowledge of the

124. *See id.* at 10 (emphasis added).

125. Another strategy to control potential litigation over power line electromagnetic fields is selection of the forum in which such arguments are resolved. For instance, in Houston Lighting and Power Co. v. Klein Independent School District, the attorneys for the utility argued that the trial court lacked jurisdiction to hear power line safety issues. The attorneys urged the appellate court to find that the Texas Public Utility Commission had exclusive jurisdiction over power line safety issues. The appellate court rejected that argument and found that site selection issues, including safety concerns, can be properly considered by both the Texas Utility Commission and the condemnation court. 739 S.W.2d. 508 (Tex. App. Houston [14th Dist.] 1987).

126. Rausch v. School Bd. of Palm Beach County, Fla., No. Cl-88-10772-AD Slip op. at 11 (Cir. Ct. 15th Cir. in and for Palm Beach County, Fla., June 8, 1989).

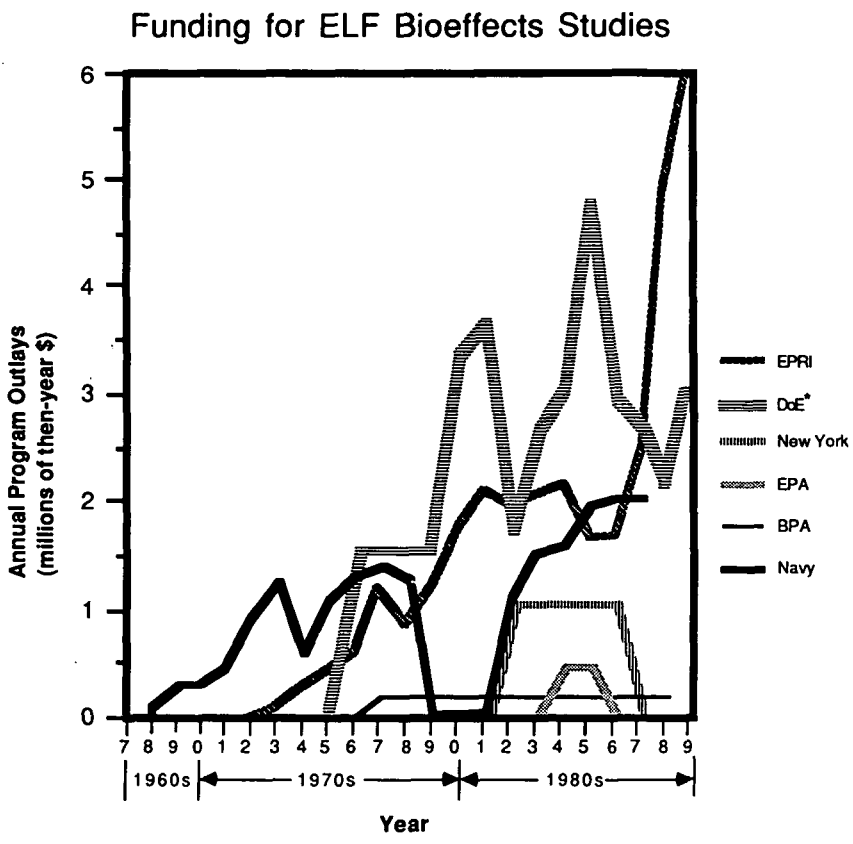
issue and the media coverage put pressure on public officials to address the issue. However, there is an element of hysteria to the press coverage in 1989. As the former regional administrator of Region II of the United States Environmental Protection Agency stated, "The public's perception of risk is seldom derived from a scientific perspective. . . .Risk alone does not drive the public perception of hazards."[127] The media attention given to electromagnetic fields should not divert scarce resources from other more proven hazards such as asbestos, air pollution, and nuclear dumps.[128]

Yet evidence of possible dangers from electromagnetic fields is increasing. While more action should be taken to protect the public from these possible dangers, the remedies should not be too excessive or onerous due to the uncertainty still surrounding these possible hazards. Much, however, can be done at little cost and with the existing tools of the legal and political communities.

The refrain heard at the end of almost every report on this issue is that more research is needed. Few can argue with that. But funding for research, while generally increasing, has been inconsistent as the following chart shows.

127. Daggett, Hazen, Shaw, *Advancing Environmental Protection Through Risk Assessment*, 14 COLUM. J. OF ENVTL. L., 315, 319-20 (1989).

128. As David Savitz commented, "[i]t's a psychological thing — you have to decide where to devote your health behavior, where to put that energy. People would rather worry about exotic, subtle, potential hazards, sometimes ignoring the very blatant ones, like drinking and driving and cigarette smoking, that people get tired of hearing about, that are profoundly more threatening." Wilson, *Storm Brews Over Weather Radar; Proposed Station's Safety Questioned*, NEWSDAY, 23 (Jan. 9, 1990).



* - Estimate for years '75-'79

As David Savitz observes, "[t]he credibility keeps growing but the money keeps shrinking."[129] The research has also been substantially funded by interested parties, not impartial sources. While this is not inherently damaging to the research since the work can still be conducted objectively, it lessens the credibility of the results. The largest funding source for most the the 1970's, for instance, was the Navy. Presently the largest percentage of funding is from the Electric Power Research Institute, an organization funded by utilities. Environmental Protection Agency funding is almost nonexistent.[130] A steady, impartial source of research funding is needed. A related problem concerns potential conflicts of interest because of expert witness fees. One controversy

129. Slesin, *Power Lines and Cancer: The Evidence Grows*, 90, No.7, TECH. REV. 52, 59 (Oct. 1987).

130. *Biological Effects*, *see supra* note 6, at 70.

revolves around officials of the National Cancer Institute — which is funding a $3.4 million epidemiologic study of leukemia and electromagnetic fields — who testified as paid witnesses for electric utilities.[131] Rather than depend on miscellaneous state funding appropriations or court ordered utility financed studies such as the New York Powerlines Project, a steady funding mechanism is needed. One possibility might be a surcharge based on transmission line right-of-ways. With an estimated 600,000 miles of transmission line in the United States,[132] a ten cent per mile annual fee should raise at least $6 million yearly and could be equitably spread among the various utilities and beneficiaries of the lines. The funds could be allocated by an independent body such as the National Academy of Sciences thereby giving more credibility to the studies. As the Office of Technology Assessment report concluded, "[t]here is a clear need for good balanced semitechnical and nontechnical treatments of this topic from 'neutral' government and private sources."[133]

A number of epidemiologic studies have indicated that children may be more vulnerable to electromagnetic fields than adults. Efforts should be taken to keep possibly more susceptible populations away from electromagnetic fields. Local municipal zoning can be used to prevent new schools, child care facilities or playgrounds from being placed near existing transmission lines. New transmission lines should be routed to avoid these types of facilities.[134] As noted earlier, there have already been judicially imposed limits for exposure of children to power line electromag-

131. *Electric Power Lines: Health and Public Policy Implications: Hearings Before the Subcomm. on General Oversight and Investigations of the Comm. on Interior and Insular Affairs*, 101st Cong., 2nd Sess. (1990). *See also* Rausch v. School Bd. of Palm Beach County, Fla., No. Cl-88-10772-AD Slip op. at 4 (Cir. Ct. 15th Cir. in and for Palm Beach County, Fla., June 8, 1989). The slip opinion stated that: "The court discounted some of the evidence presented by the defendant because of the financial ties of many of the defendant's witnesses to the power industry."

132. Slesin, *Power Lines and Cancer: The Evidence Grows*, 90, No. 7 TECH. REV. 52 (Oct., 1987). The Office of Technology Assessment report places the length of transmission lines in the United States at 350,000 miles. *Biologic Effects*, *see supra* note 6, at 4.

133. *Biological Effects*, *see supra* note 6, at 77.

134. One proposal which would encourage utilities to site new power lines in a way to minimize population exposure to electromagnetic fields is to implement an exposure fee. By charging the utility a fee for each person exposed to a certain level of electromagnetic fields due to a new power line not only would utilities be encouraged to place power lines where the least number of people would be exposed, but the funds collected from such a fee could be used to finance further research on electromagnetic fields. Morgan, Florig, Nair and Hester, *Controlling Exposure to Transmission Line Electromagnetic Fields: A Regulatory*

netic fields. In response to an action initiated by concerned parents of children in the Sandpiper Shores Community Elementary School, a judge in Palm Beach, Florida ordered the school board to prevent the children from playing in a portion of a playground because of the presence of power lines.[135]

Rather than eventually having remedial actions taken to limit the exposure of those potentially vulnerable to electromagnetic fields, it is preferable to take prospective actions to minimize such exposure. For example, as previously noted, the California School Siting Policy is a prudent, forward looking measure which will hopefully limit the need for future corrective actions. Professional planners are also becoming aware of the issue. A planner recently advocated in the Journal of the American Planning Association that there is a "need to alert planners to a potential public health hazard" posed by power line electromagnetic fields.[136] The author urged planners to consider power line electromagnetic fields when practicing their profession.

As discussed previously, the existence of apparent "windows" of biological effects argues against setting only threshold field strength standards. "While simple field strength standards may be administratively convenient for both regulators and utilities, they unfortunately can not be justified on the basis of the available science. If they are represented as assuring safety they may produce a false sense of protection and in some circumstances could arguably do more harm than good."[137] Until more is known about the "windows" of biological effects, field standards should be supplemented by other safety measures.

Approach that is Compatible with the Available Science, 121, No. 6 PUB. UTIL. FORT. 49 (March 17, 1988).

135. Rausch v. School Bd. of Palm Beach County, Fla., No. Cl-88-10772-AD (Cir. Ct. 15th Cir. in and for Palm Beach, Fla., June 8, 1988).

136. Goldsteen, *Viewpoint*, 55, No. 1 PLANNING 50 (Jan. 1989). The author states:

> I have become aware of a little known body of scientific research that strongly suggests a correlation between electrical energy distribution, electromagnetic fields, and human health. As a result, I have become convinced of the need to alert planners to a potential public health hazard. . . .What planners should be doing is to prepare risk assessment studies for a variety of potential health hazards. . . .The implications for practice and research are endless. Planners might, for example, use epidemiological studies correlating electromagnetic fields with incidence of leukemia to help in siting new schools. Planners may also find it necessary to supplement existing zoning and subdivision ordinances with additional regulatory documents relating to the newly discovered dangers. . . .

137. *Biological Effects*, *see supra* note 6, at 76.

For instance, future transmission lines might be required, as a prudent safety measure, to have wider right-of-ways. Existing transmission lines can be restrung to minimize the sag of the lines and to maintain the height of the lines off the ground. These safety measures may increase the time necessary to approve new transmission lines. The wider right-of-ways will also increase the cost of power to utilities and, ultimately, rate payers. Conceivably, however, the wider right-of-ways may allay fears over electromagnetic fields and actually speed the approval of new power lines by eliminating potential lawsuits and objections against such power lines.

There may be over emphasis on transmission power lines. A far greater hazard may exist in household appliances, distribution lines and household wiring. The Office of Technology Assessment report states: "[F]ields associated with distribution lines. . .building wiring, and appliances could be the primary source of public health impact. . . .[E]normous attention may be devoted to one, possibly minor, source of public exposure (power lines) while ignoring many other, possibly major, sources of public exposure. . . ."[138] Distribution lines, for example, have no right-of-ways and are more extensive than power transmission lines.[139] More research should be directed in these areas. Eventually, depending on the outcome of such research, appliances, household wiring and distribution lines can be redesigned or placement guidelines developed to minimize exposure to the electromagnetic fields they create. Such redesign may not necessarily be expensive and may occur in response to market demand.[140] IBM, for instance, has already begun marketing a video display terminal with low electromagnetic fields.[141] One low cost partial solution to the potential appliance hazard may be to permit consumers to make informed choices. Electromagnetic field strengths might be required to be listed on appliances just as certain appliances presently have to list energy efficiency ratings.

138. *Id.* at 75.

139. The Office of Technology Assessment report states that there are more than 350,000 miles of power transmission lines and 2,000,000 miles of distribution lines in the United States. *Id.* at 4.

140. *Id.* at 80.

141. Lewis, *I.B.M.'s Low-Radiation Monitors*, N.Y. Times, Dec. 10, 1989. This article reports that the new monitors with lower user exposure to electromagnetic fields actually perform better at a slightly lower cost than the prior models.

More action on a federal level is needed so there will be consistency in any future appliance standards. Different field standards currently exist for right-of-ways on a state level. If more attention is placed on household appliances, electromagnetic field standards may eventually be set for appliances on a state level. Differing state standards would create great difficulties for manufacturers.

As this note has shown, courts use three standards in addressing the issue of power line electromagnetic fields. Which standard the court uses is of great importance depending on the plaintiff's concern. If the plaintiff is a property owner simply trying to get condemnation compensation, the majority standard is preferable. However, if the plaintiff is using the court as a forum in which to gain protection from a perceived health threat, then the intermediate standard is preferable despite its more demanding requirements. By requiring proof of the reasonableness of fears over electromagnetic fields, the intermediate standard requires review of expert testimony on possible health effects of electromagnetic fields. As more scientific data is collected on electromagnetic fields, the plaintiff will have an improved chance of not only placing the health issue on the agenda of environmental issues to be addressed by the judicial or legislative systems, but also of prevailing in court. Because of studies completed over the past several years and the increased legitimacy given electromagnetic field health concerns by the Office of Technology Assessment and Powerlines reports, courts following the intermediate standard should find such fears reasonable. For just such reasons the *Zappavigna* decision may be modified on appeal.

In the past four years much has happened in this field. The Office of Technology Assessment report was completed. The New York Powerlines Project report, including the Savitz study substantiating the Wertheimer/Leeper and Tomenius research, was released. *San Diego* and *Zappavigna* were decided. A wave of publicity over electromagnetic fields occurred during 1989. Attention is being focused on hitherto untouched areas: household appliances and distribution lines. Evidence supporting the belief that transmission lines may cause health hazards has been increasing.

While there is still no definitive proof of human health hazards from electromagnetic fields, a strategy of prudent avoidance of such fields should be followed. Such a strategy is already being

implemented on local levels as seen by the California school siting policy. At this time extreme, costly measures are not called for. However, prudent prospective measures should be taken. In the long term, these measures will be less expensive and more effective than potentially costly remedial steps.

Whatever the reaction is to electromagnetic fields — denial of a possible problem, prudent avoidance and additional research or extreme over-reaction — the issue is not going to disappear. As water and air pollution were to the 1970's, and hazardous waste and toxic chemicals to the 1980's, electromagnetic fields will be an environmental issue of the 1990's.

John Weiss