CAO PLC Exhibit 14

The Middletown Press (middletownpress.com), Serving Middletown CT and surrounding areas

News

CL&P power line project brings suits; Durham couple involved

Tuesday, October 13, 2009 10:48 PM EDT

By LUTHER TURMELLE, Journal Register News Service

A New Haven attorney has filed five lawsuits against Connecticut Light & Power Co. on behalf of clients in Wallingford, Milford, Orange and Durham over the utility's handling of the Middletown-to-Norwalk power line upgrade, which went into service in December.

The lawsuits filed by Benson Snaider come three months after the company reached an undisclosed settlement with four families, including three from this area, whose cases against CL&P were scheduled to go to trial in July.

Snaider represented the families that settled with the company in July, and the latest lawsuits filed were submitted weeks before the statute of limitations was scheduled to run out in some of the cases.

In all but one of the latest lawsuits, Snaider is contending that CL&P overstepped certain rights given to it in a 1924 easement agreement signed when the power lines were first erected.

All of the plaintiffs own property that comes with an easement allowing utilities access to the power lines.

One lawsuit, filed on behalf of Wendy Coppola of Milford, relies solely on a nuisance complaint. It claims that the new 345-kilovolt power lines erected next to her property are a nuisance because they emit loud noises, are unsightly and encourage people to trespass on gravel access roads that were put in place to allow utility crews to service the lines in the future.

The nuisance complaint is also included in the other four lawsuits, which were filed on behalf of two Orange clients — Michael Campanelli, and Ronald and Michelle Cybart — as well as John Verna of Wallingford, and Donald and Dorothy Gates of Durham.

Frank Poirot, a CL&P spokesman, declined to comment on the lawsuits.

Snaider said that the Cybarts' case is especially interesting because an electrician working recently on outdoor lighting in the backyard of their High Plains Road home found that electromagnetic fields from the power line were so strong they set off alarms on a voltage meter that he carries with him.

When the Connecticut Siting Council was reviewing plans for the route of the power lines earlier in the decade, a number of towns affected by the upgrade raised concerns that exposure to electromagnetic fields could cause cancer, particularly in young children.

Luther Turmelle can be reached at **lturmelle@nhregister.com** or 789-5706.

CAOPLC Exhibit #1

Click here to print

Mail Online

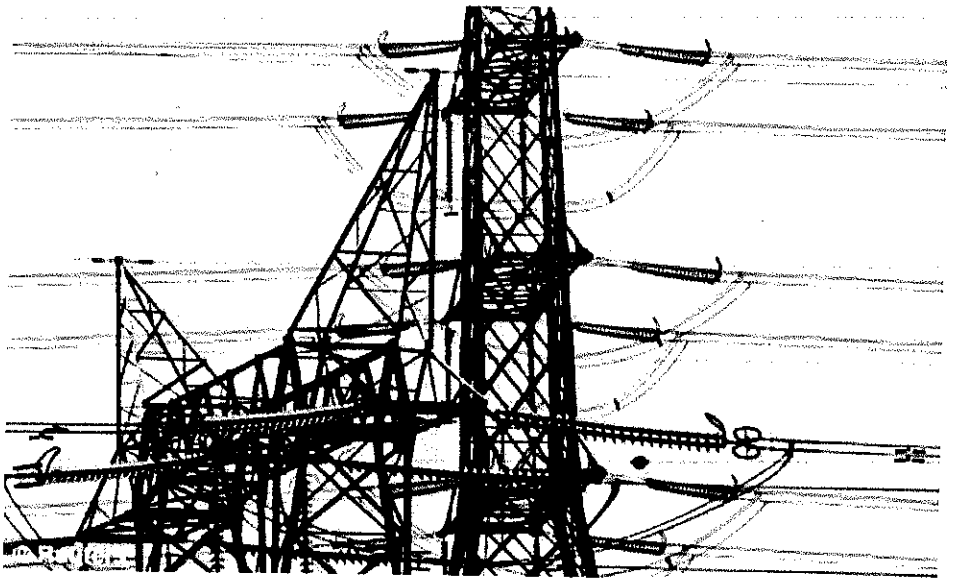
Faulty gene makes children who live near power lines more likely to develop leukaemia

By Nic Fleming
Last updated at 11:28 PM on 20th December 2008

Scientists have found new evidence of a link between overhead power lines and childhood leukaemia.

They have identified a defective gene that quadruples the risk of cancers of the blood and bone marrow for carriers who live within 330ft of an overhead cable.

The discovery could help explain the findings of a Government-funded study published three years ago.



Living near high-voltage power lines increases the risk of childhood leukaemia

It concluded that children who grew up near high-voltage power lines were, on average, almost 70 per cent more likely to be diagnosed with leukaemia than those living further away.

Previous studies have suggested that exposure to the electromagnetic fields (EMFs) created around power lines can cause damage to the DNA, or genetic blueprint, of animal cells.

The latest research, which is from China, shows that one in 20 children inherits a faulty copy of a gene that normally helps repair DNA damage, making them more vulnerable to developing leukaemia when young.

Last year, an expert committee set up by the Government urged Ministers to ban new homes and schools from being built near high-voltage lines.

Alasdair Philips, who runs the campaign group Powerwatch, said: 'Previous studies have shown a clear association between childhood leukaemia and EMFs from power lines.

'The new study supports this, along with a genetic explanation, and we should urgently replicate this research in the UK.

'In the meantime, the Government should implement a five-year building moratorium to keep homes and schools at least 200ft away from power lines.'

Health minister Dawn Primarolo and fellow ministers were due to discuss the risk of living near power lines this week, but the meeting was cancelled

Scientists at the Jiao Tong University School of Medicine in Shanghai studied 123 children under 15 with leukaemia and found that those with a faulty variant of the XRCC1 gene were 4.3 times more likely to develop leukaemia if they lived within 330ft of a power line or an electricity transformer.

The defective variant gene has previously been linked to increases in the risk of breast and prostate cancer developing.

Louis Slesin, editor of Microwave News, a US website that reports on EMFs and their health risks, said: 'The study will need to be repeated, but it is like finding the missing piece of the jigsaw.'

Last Wednesday, Health Minister Dawn Primarolo was due to meet Housing Minister Iain Wright and Energy Minister Mike O'Brien to discuss the Government's response to the conclusions reached by the expert committee last year, but the meeting was postponed 'due to a busy parliamentary timetable'.

Chantelle Roberts of the charity Children With Leukaemia said: 'The risk of childhood leukaemia associated with EMFs from high-voltage power lines cannot be ignored.

'The Government should act now to ban the building of new houses under high-voltage power lines to protect children's health.'

Comments (19)

- Newest
- Oldest
- Best rated
- Worst rated

CAOPLC Exhibit 2

References

1 Le Conseil des ministres réaffirme que le corps humain ne peut faire l'objet d'un brevet. *Associated Press*, 31 October 2001
2 Gold, E.R. and Gallochat, A. (2001) The European biotech directive: past as prologue. *Eur. Law J.* 7, 328–366
3 Ekpere, J.A. (2000) *OAU model law: African model legislation for the protection of the right of local communities, farmers and breeders, and for the regulation of access to biological resources*, OAU/STRC PMB 2359, Organization of African Unity
4 Bursaux, E. (2001) La mainmise d'une société américaine sur le dépistage génétique du cancer du sein contestée. *Le Monde*, 7 September 2001 (http://www.lemonde.fr/imprimer_article/0,6063,220864,00.html)
5 Ontario defies U.S. gene company over cancer test, arguing health care at risk. *Canadian Press*, 19 September 2001
6 Gold, E.R. (2000) Finding common cause in the patent debate. *Nat. Biotechnol.* 18, 1217
7 Daar, A.S. and Mattei, J-F. (1999) *Annex 1 of the report of the informal consultation on ethical issues in genetics, cloning and biotechnology: possible future directions for WHO*. WHO/EIP/GPE/00.1, World Health Organization
8 Human Genome Organization Ethics Committee (2000) Genetic benefit sharing. *Science* 290, 49
9 Knoppers, B.A. *et al.* (1999) Genetic technologies: commercialization of genetic research and public policy. *Science* 286, 2277–2278
10 Caulfield, T.A. *et al.* (2000) Patenting human genetic material: refocusing the debate. *Nat. Rev. Genet.* 1, 227–231
11 Lanjouw, J.O. (2001) *A Patent Proposal for Global Diseases*, The Brookings Institution, Washington, DC, USA
12 Gallini, N.T. and Wright, B.D. (1990) Technology transfer under asymmetric information. *Rand J. Econ.* 21, 147–160
13 Markusen, J.R. (2001) Contracts, intellectual property rights, and multinational investment in developing countries. *J. Int. Econ.* 53, 189–204
14 Singer, P.A. and Daar, A.S. (2000) Avoiding Frankendrugs. *Nat. Biotechnol.* 18, 1225
15 Nuffield Council on Bioethics (1999) *Genetically Modified Crops: the ethical and social issues*, Nuffield Council on Bioethics
16 Glass, A.J. and Saggi, K. (2002) Licensing versus direct investment: implications for economic growth. *J. Int. Econ.* 56, 131–153
17 Gallini, N. and Scotchmer, S. (in press) Intellectual property: when is it the best incentive system. In *Innovation Policy and the Economy, Vol. 2* (Jaffe, A. *et al., eds*), pp. 51–78, MIT Press
18 Maskus, K.E. (2001) *Intellectual Property Rights in the Global Economy*, Institute for International Economics, Washington, DC, USA
19 Sakakibara, M. and Branstetter, L. (2001) Do stronger patents induce more innovation? Evidence from the 1988 Japanese patent law reforms. *RAND J. Econ.* 32, 77–100
20 Hall, B.H. and Ziedonis, R.M. (2001) The patent paradox revisited: an empirical study of patenting in the U.S. semiconductor industry, 1979–1995. *RAND J. Econ.* 32, 101–128
21 Cohen, W.M. *et al.* (2000) *Protecting their intellectual assets: appropriability conditions and why U.S. manufacturing firms patent (or not)*, Working Paper 7552, National Bureau of Economic Research, Cambridge, MA, USA
22 Besson, J. and Maskin, E. (2000) *Sequential Innovation, Patents, and Imitation*, Working Paper 00-01, Dept of Economics, Massachusetts Institute of Technology, Cambridge, MA, USA
23 Burch, R.K. *et al.* (2000) Divergent incentives to protect intellectual property: a political economy analysis of North–South welfare. *J. World Intell. Prop.* 3, 169–196
24 Glass, A.J. (2000) Costly R&D and intellectual property rights protection. *Int. J. Tech. Manag.* 19, 179–193
25 Helpman, E. (1993) Innovation, imitation, and intellectual property rights. *Econometrica* 61, 1247–1280
26 Santaniello, W. *et al.*, eds, (2001) *Agriculture and intellectual property rights: Economic, institutional and implementation issues in biotechnology*, Oxford University Press
27 Smith, P.J. (2001) How do foreign patent rights affect U.S. exports, affiliate sales, and licenses. *J. Int. Econ.* 55, 411–439
28 Smith, P.J. (1999) Are weak patent rights a barrier to U.S. exports? *J. Int. Econ.* 48, 151–177
29 Hunt, R. (1999) Patent reform: a mixed blessing for the U.S. economy? In *Business Review – Federal Reserve Bank of Philadelphia* (Nov–Dec 1999), pp. 15–29, Federal Reserve Bank of Philadelphia, PA, USA
30 Lee, J-Y. and Mansfield, E. (1996) Intellectual property protection and U.S. foreign direct investment. *Rev. Econ. Stat.* 78, 181–186
31 Merges, R.P. and Nelson, R.R. (1992) Market structure and technical advance: the role of patent scope decisions. In *Antitrust, Innovation, and Competitiveness* (Jorde, T.M. and Teece, D.J., eds), pp. 185–132, Oxford University Press
32 Heller, M.A. and Eisenberg, R.S. (1998) Can patents deter innovation? The anticommons in biomedical research. *Science* 280, 698–701
33 Gold, E.R. and Caulfield, T.A. (in press) The 'moral tollbooth': using the patent system to address ethical concern. *Lancet*

Toxicogenomics and toxic torts

Gary E. Marchant

One of the first practical applications of toxicogenomics will probably be in the context of toxic tort personal injury litigation. Gene expression changes that 'fingerprint' exposure to particular classes of toxic substances can potentially be used to demonstrate exposure, prove causation and support novel damage claims in lawsuits brought by citizens injured by toxic exposures. Although the potential use of toxicogenomic data in toxic tort litigation is immense, there is a danger of premature use of such data before they have been adequately validated and characterized.

Gary E. Marchant
Center for the Study of Law, Science and Technology, Arizona State University College of Law, PO Box 877906, Tempe, AZ 85287-7906, USA.
e-mail: gary.marchant@asu.edu

Toxicogenomics is the study of the response of the genome to toxic agent exposure; it has been described as 'a tool of unprecedented power' in toxicology [1]. The term 'toxicogenomics' in its broadest meaning encompasses profiling of gene expression, protein composition (proteomics) and the metabolic constituents (metabonomics) of a cell. A key toxicogenomic technique is to profile (using a DNA microarray or 'gene chip') the cell-wide changes in gene expression following exposure to toxins. This approach creates the potential to provide a molecular 'fingerprint' of exposure or toxicological response to specific classes of toxic substances [1–3].

Gene expression changes measured by DNA microarrays can provide a more sensitive and characteristic marker of toxicity than typical toxicological endpoints such as morphological changes, carcinogenicity and reproductive toxicity [4]. Moreover, altered gene expression can occur immediately following exposure, whereas the clinical manifestation of toxicity might take days, months or even years to develop. Initial 'proof-of-principle' experiments have successfully identified the category or toxicological mechanism of toxic chemicals on the basis of their gene expression profiles [3,5,6]. The potential promise of this technology is enormous. For example, DNA microarrays could be used to identify or confirm the category of toxic substances to which an individual was exposed, based on gene expression profiling.

Notwithstanding the tremendous potential of gene expression profiling, many obstacles and uncertainties remain to be resolved before toxicogenomic data should be used outside the research context for practical, regulatory or legal applications [7,8]. The toxicological significance of gene expression changes must be validated, including

http://tibtech.trends.com 0167-7799/02/$ – see front matter PII: S0167-7799(02)01992-3

an evaluation of the robustness of microarray results between or across different laboratories, species, individuals, tissues and time periods [4]. For example, it will be important to understand the time course of gene expression changes following toxic exposures because some alterations might be transient and others might lead to permanent changes.

One of the most difficult issues will be in differentiating gene expression changes that represent the adaptive response of cells to external stimuli that have no toxicological significance or increased risk from those gene expression changes that truly represent the early stages of disease progression [9]. For example, some changes in gene expression might simply represent a nonspecific and fully reversible response of the cell to stress or a response with no biological consequence. Given the massive quantity of data produced by a DNA microarray, there will almost certainly be many false positive results. There will also be difficult quality control and consistency issues with respect to data collection, storage, interpretation and display [2,4].

One of the first practical applications of toxicogenomics outside the research context will probably be in toxic tort litigation. A 'tort' lawsuit is one brought by a private citizen ('plaintiff') against another person or entity ('defendant') for compensation ('damages') of an injury allegedly caused by the defendant's wrongful act. When the wrongful act involves or results in exposure to a toxic agent, the case is classified as a 'toxic tort'. The plaintiff in a toxic tort lawsuit has to prove that the toxic exposure resulting from the defendant's act caused his or her injuries. The fair and reasonable resolution of such lawsuits is hindered by the numerous uncertainties and difficulty in proving whether a specific toxic exposure caused a particular plaintiff's disease. Consequently, many victims harmed by toxic substances are denied fair compensation for their injuries, whereas some apparently innocuous products (e.g. Bendectin and silicone breast implants) have been forced off the market by unwarranted liability.

Toxicogenomics has the potential to make toxic tort litigation more objective, fair and efficient. Just as forensic DNA evidence has helped to indict guilty criminals and exonerate innocent suspects, toxicogenomic data have the potential both to help injured victims recover damages and to assist innocent companies in defending against liability. At the same time, this new technology will present major evidentiary challenges for judges and juries.

There are no reported toxic tort cases to date in which toxicogenomic data have had a significant role. Legal commentators have, nevertheless, begun to focus on potential tort applications of genomic techniques [10–13]. These potential applications include using gene expression data to demonstrate exposure, to prove causation and to recover novel types of damages, such as for increased risks than have not yet manifested into symptomatic disease ('latent risks'). Using analogous precedents from US case law, these potential uses of toxicogenomics in toxic tort litigation are discussed in the following section.

Demonstrating exposure

Injured plaintiffs have to prove that exposure to a defendant's toxic agent is sufficient to cause their illness. In many cases, such as those involving contaminated groundwater, pesticide use or air pollution, direct quantitative evidence of exposure is lacking, often resulting in the case being dismissed. Toxicogenomics could assist plaintiffs in demonstrating exposure or could support the defendant's counter-argument that there was no significant exposure. Gene expression assays of the plaintiff's blood or skin cells might demonstrate the presence (or absence) of gene expression 'fingerprints' that are characteristic of the class of toxic substances to which that person was allegedly exposed. If adequately developed, such an assay could quantify the level, or even the duration, of a plaintiff's exposure.

This application would obviously raise many evidentiary questions. For example, how well characterized and validated is the gene expression 'fingerprint'? How specific and sensitive is the gene expression profile with respect to the toxic agent at issue? Are the gene expression changes in the easily assayed tissues such as blood or skin cells representative of the changes in the less accessible tissue in which the disease actually occurs? Can other potential sources of exposure to that same toxic substance (or to other substances that cause similar responses) be excluded? What is the quantitative relationship between the level of exposure and the magnitude of the gene expression changes? Over what range of exposure is this relationship valid? Do inter-individual differences in susceptibility (genetic or non-genetic) affect gene expression patterns in different individuals? How does gene expression vary with single, acute exposures versus long-term chronic exposure? What is the time course of the gene expression changes following toxic exposure, and are these changes transient or long-term (Box 1)? Notwithstanding these important uncertainties and limitations, gene expression changes assayed using DNA microarrays could provide more informative and objective evidence of exposure than is typically available in toxic tort litigation.

Proving causation

Toxic tort plaintiffs must prove that their exposure to a toxic substance caused their illness. Legal causation in toxic tort cases has two elements. The first is general causation, which addresses whether the toxic substance produced by the defendant is capable of causing the health effect incurred by the plaintiff. Second, specific causation asks whether the toxic agent did, in fact, cause the health effect in that specific plaintiff. Toxicogenomic data could be relevant to both steps of the causation analysis.

With respect to general causation, most courts have insisted that the only relevant data are those involving both the precise toxic agent and exact health effect

Box 1. Temporal dimension of genetic changes

Litigation over the 1979 Three Mile Island (TMI) nuclear accident demonstrates the importance of the temporal dimension for genetic biomarkers of exposure. A class of residents living near the facility filed a lawsuit claiming that they developed cancer as a result of an alleged radioactive plume released during the accident. However, they lacked direct evidence to prove or quantify their radiation exposure [a]. The plaintiffs attempted to demonstrate their exposure based on an increased frequency of dicentric chromosomes in their lymphocytes, arguing that these genetic changes represented a quantitative biomarker of radiation exposure. The Court of Appeals held that the use of such genetic markers is a 'valid and reliable scientific methodology' for quantifying exposure but that its 'validity and reliability decrease as the time gap between the alleged irradiation and the dicentric count increases'. The court found that dicentric chromosomes could only provide an accurate indicator of dose within one or two years of exposure, and thus the plaintiffs' dicentric chromosome levels assayed 15 years after the TMI accident were no longer a reliable measure of exposure. In the same way, the time that lapses between exposure and measurement of gene expression changes in an exposed person will be a crucial factor in determining the validity, and hence admissibility, of such evidence.

Reference

a *In re TMI Litigation*, 193 F.3d 613 (3d Cir. 1999), *cert. denied*, 120 S.Ct. 2238 (2000)

involved in the case. Thus, courts have generally been unwilling to allow plaintiffs to rely on evidence showing that the same chemical can cause other comparable diseases. For example, a plaintiff with brain cancer will often be precluded from relying on evidence that the same chemical causes liver tumors or leukemia. Similarly, plaintiffs have been precluded from relying on evidence showing that structurally related or similar chemicals can cause the same health effect for which they have been diagnosed.

Given that most toxic substances have not been tested for many toxicological end points, data will be lacking for most specific chemical-endpoint combinations, even if some of these combinations involve a true causal association. Toxicogenomic data might be able to provide the necessary missing link in such cases and prove the absence of such linkages in other cases. For example, a study showing that the toxic substance to which the plaintiff was exposed produces a gene expression 'fingerprint' characteristic of chemicals known to cause the health effect from which the plaintiffs suffers might be probative of general causation in the absence of any data directly linking the specific chemical and health effect. This type of evidence will no doubt be controversial and subject to severe challenges by the opposing side but nevertheless, might, at least in some cases, provide the missing link that plaintiffs need to establish general causation. Conversely, a defendant might be able to use toxicogenomic data to show that its product does not produce a gene expression profile consistent with the plaintiff's disease to rebut general causation (Box 2).

Toxicogenomic data could also be relevant to specific causation, in which a plaintiff must prove that the toxic exposure did, in fact, cause his or her disease. 'Particularistic' data showing that a specific individual's disease was caused by a particular exposure is extremely rare, if not non-existent, using current toxicological methods [14]. Applying toxicogenomics, a plaintiff could assay for changes in gene expression in his or her cells that are characteristic of the specific agent produced by the defendant. The types of gene expression changes that would be most relevant are not those of the initial cellular response to toxic agent exposure but the subsequent gene expression changes that are typical of the progressing disease process. In other words, the gene expression changes potentially relevant to the causation inquiry must go beyond those simply showing the fact of exposure and also represent genetic changes that are indicative of a disease process. Such evidence directly linking the toxic agent with the disease process in the individual plaintiff is likely to be highly persuasive to judges and juries. By analogy, the scientific experts who testified on behalf of silicone breast implant recipients claimed that specific antibodies found in some women with silicone breast implants provided a biomarker connecting leaking silicone with the development of disease. This testimony was highly influential to jurors, who awarded large damages to plaintiffs, even though these antibody tests were subsequently found to be invalid and unreliable [10,15].

Box 2. Disproving causation

A corporate defendant successfully used the absence of a genetic biomarker to defend against liability in a case in which the family of a deceased worker alleged that occupational exposure to benzene caused the worker's acute myelogenous leukemia (AML). The defendant did not dispute that benzene is capable of causing AML, but instead argued that benzene only causes the types of AML that have specific cytogenetic markers – breaks in the fifth and seventh chromosomes. The jury found in the defendant's favor based on the lack of such specific genetic changes in the cells of the deceased worker [a]. A different court rejected the same argument a few weeks later as 'nothing more than an untested, unsupported hypothesis cloaked in the aura of scientific knowledge' [b]. The presence or absence of gene expression changes could provide an even more specific and common genetic biomarker of causation than the chromosomal aberrations involved in these benzene cases, but the use of toxicogenomic data for such a purpose is also likely to be highly controversial. As greater understanding of the roles of specific genes in the toxicological response to particular toxins develops, however, toxicogenomic data showing changes in the expression of those genes will provide an increasingly informative and reliable marker of causation.

References

a *Wells v. Shell Oil Co.* (DCE Texas. Jury verdict March 2, 1998)

b *Lavender v. Bayer Corp.* (W. Va. Cir. Ct. No. 93-C-226-K, May 29, 1998)

Recovery for latent risks

The traditional rule in tort law is that 'the threat of future harm, not yet realized, is not enough' [16]. Notwithstanding this admonition, in recent years plaintiffs exposed to hazardous substances have increasingly sought recovery for latent risks that have not yet manifested into clinical disease. Such claims usually seek damages for the increased risk of future disease, recovery for the present fear associated with the increased risk, or costs for periodic medical monitoring [17].

To prevent a flood of latent risk claims, while also providing the possibility of recovery for the most compelling cases, courts have imposed threshold requirements for such claims. For example, most courts require proof of a 'present injury' for most increased risk and fear of disease claims, as well as a demonstration (and often quantification) of a sufficient quantum of

Box 3. Defining 'present injury'

A threshold requirement for recovery for a latent risk is that the plaintiff must have incurred a 'present injury'. Courts differ in the extent of impact that is necessary to meet this requirement. A few courts have taken the position that the mere fact of exposure is sufficient to establish a 'present injury'. Thus, the Tennessee Supreme Court has held that 'ingest[ing] an indefinite amount of a harmful substance' is itself a 'physical injury' [a].

Other courts have required evidence of an adverse physiological change as a result of the exposure, even if such changes occur at the subcellular level and are without detectable symptoms. For example, one court held that chromosome damage inferred from radiation exposure can be a 'physical injury' [b]. Finally, other courts have required 'an objectively verifiable functional impairment' before a present injury is recognized [c]. Gene expression changes associated with toxic exposures could span the range from adaptive responses to exposure with no toxicological significance, to subcellular manifestations of toxicity not associated with clinical symptoms, to changes that are associated with a functional impairment. The relevance of gene expression data associated with such changes will depend on how the reviewing court construes the term 'physical injury'.

References

a *Laxton v. Orkin Exterminating Co.*, 639 S.W.2d 431 (Tenn. 1982)
b *Brafford v. Susquehanna Corp.*, 586 F. Supp. 14 (D. Colo. 1984)
c *In re Hawaii Federal Asbestos Cases*, 734 F. Supp. 1563 (D. Hawaii 1990)

increased risk [17,18]. Most plaintiffs exposed to hazardous substances are currently unable to meet these threshold evidentiary requirements, although some courts permit chromosomal or other subcellular changes to be inferred from exposure (Box 3).

Gene expression data could help many plaintiffs trigger recovery, by demonstrating both an existing 'injury' and a sufficient increase in risk. By providing a highly sensitive and specific marker of a toxicological response, microarray data could provide adequate demonstration of a present physical injury. A crucial issue will involve distinguishing gene expression changes that are merely adaptive responses from those that truly represent disease pathology (Box 3). Likewise, gene expression data might provide objective empirical evidence of increased risk, which might satisfy the requirement that the plaintiff demonstrates a sufficiently enhanced risk.

Plaintiffs at risk from exposure to hazardous substances might also seek compensation to conduct periodic medical monitoring using DNA microarrays to evaluate their disease status and progression. To recover medical monitoring costs, most courts require: (1) that plaintiffs demonstrate a significantly increased risk of contracting a serious latent disease; (2) that this increased risk makes periodic diagnostic medical examinations reasonably necessary; and (3) that the monitoring and diagnostic methods used make early detection and treatment of the disease both possible and beneficial [19]. Gene expression assays could provide a more informative assessment of pre-clinical disease progression than currently available medical tests for many latent conditions. This assessment has the potential to greatly expand the number of potential medical monitoring claims, and will force courts and legislatures to confront the policy implications of this new type of liability.

Conclusion

As the cases discussed above demonstrate, several doctrinal templates for the application of toxicogenomic data to toxic tort litigation already exist. The use of gene expression data within these existing legal frameworks has the potential to make the resolution of toxic tort litigation more scientifically objective, fair and efficient. Plaintiffs might use these data to demonstrate exposure, causation or latent risks, and defendants could use the same type of data to refute such assertions.

There are many scientific [7,8] and legal [11,13] issues relating to the validation, quality control and significance of toxicogenomic data that remain to be addressed before the data should be applied in a non-research context. Toxic tort litigants have very little incentive to wait for these uncertainties to be fully resolved because, unlike scientists or regulators who have the luxury of revisiting their decisions, litigants are one-time players in a high-stakes game. Therefore, there will be temptation to use toxicogenomic data in toxic tort lawsuits prematurely, just as has occurred in the past with other types of novel scientific evidence [10]. The US Supreme Court recently held that trial judges must serve as scientific 'gatekeepers' to ensure that scientific evidence admitted into evidence is both 'reliable' and 'relevant' [20]. Toxicogenomic data are certain to provide a new challenge for this gatekeeping role, probably much sooner than most lawyers and scientists realize.

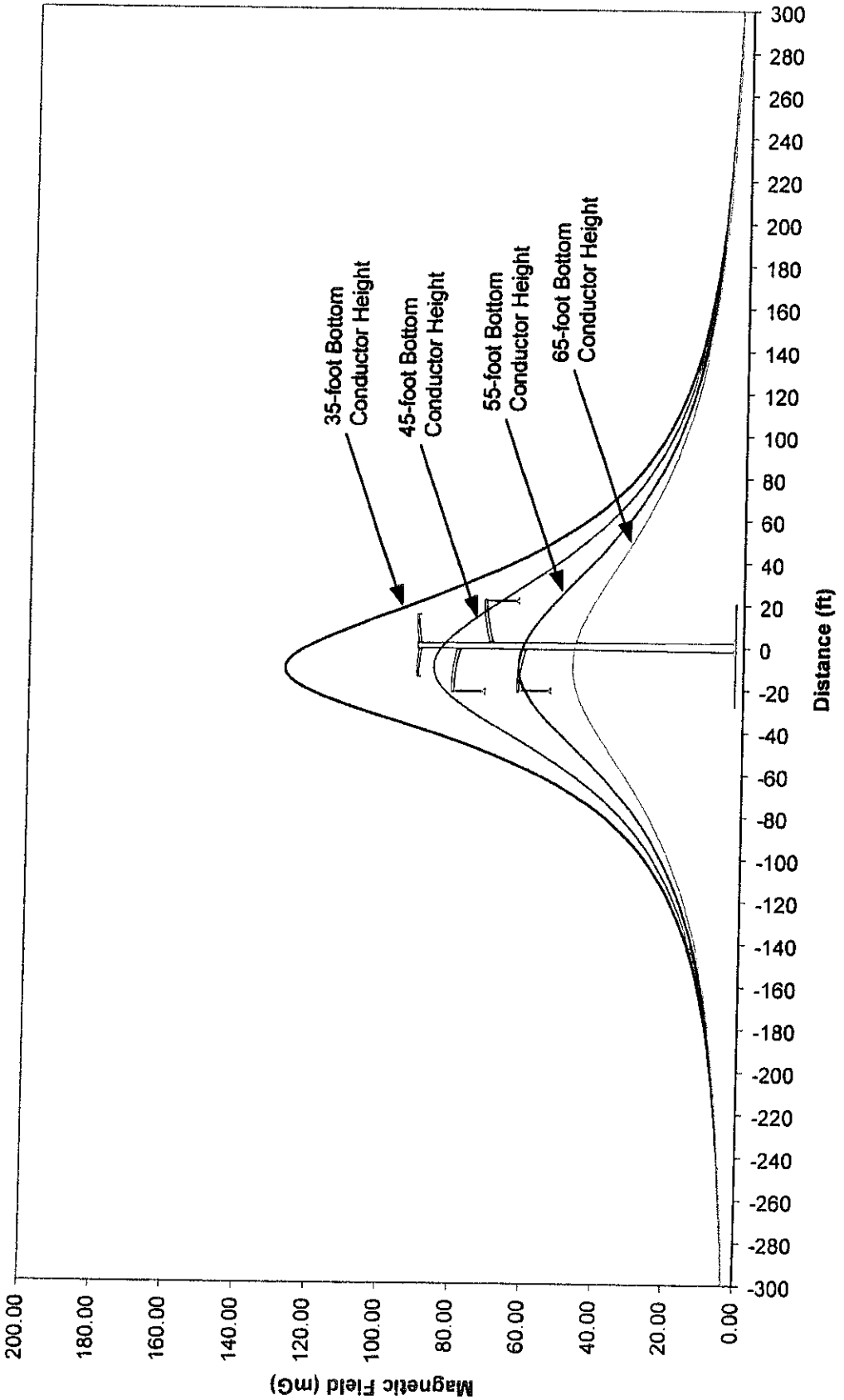
References

1 Nuwaysir, E.F. *et al.* (1999) Microarrays and toxicology: the advent of toxicogenomics. *Mol. Carcinog.* 24, 153–159
2 Aardema, M.J. and MacGregor, J.T. (2002) Toxicology and genetic toxicology in the new era of 'toxicogenomics': impacts of '-omics' technologies. *Mutat. Res.* 499, 13–25
3 Thomas, R.S. *et al.* (2001) Identification of toxicologically predictive gene sets using cDNA microarrays. *Mol. Pharmacol.* 60, 1189–1194
4 Hamadeh, H.K. *et al.* (2001) Discovery in toxicology: mediation by gene expression array technology. *J. Biochem. Mol. Toxicol.* 15, 231–242
5 Burczynski, M.E. *et al.* (2000) Toxicogenomics-based discrimination of toxic mechanisms in HepG2 human hepatoma cells. *Toxicol. Sci.* 58, 399–415
6 Waring, J.F. *et al.* (2001) Clustering of hepatoxins based on mechanism of toxicity using gene expression profiles. *Toxicol. Appl. Pharmacol.* 175, 28–42
7 Fielden, M.R. and Zacharewski, T.R. (2001) Challenges and limitations of gene expression profiling in mechanistic and predictive toxicology. *Toxicol. Sci.* 60, 6–10
8 King, H.C. and Sinha, A.A. (2001) Gene expression profile analysis by DNA microarrays. *JAMA* 286, 2280–2288
9 Pennie, W.D. *et al.* (2000) The principles and practice of toxicogenomics: applications and opportunities. *Toxicol. Sci.* 54, 277–283
10 Marchant, G.E. (2000) Genetic susceptibility and biomarkers in toxic injury litigation. *Jurimetrics* 41, 67–109
11 Marchant, G.E. (2001) Genetics and toxic torts. *Seton Hall L. Rev.* 31, 949–982
12 Callahan, C.P. (2001) Molecular epidemiology: future proof of toxic tort causation. *Environ. Lawyer* 8, 147–166
13 Poulter, S.R. (2001) Genetic testing in toxic injury litigation: the path to scientific certainty or blind alley? *Jurimetrics* 41, 211–238
14 *In re Agent Orange Prod. Liab. Litig.*, 597 F. Supp. 740 (E.D.N.Y. 1984)
15 *Hall v. Baxter Healthcare Corp.*, 947 F. Supp. 1387 (D. Oregon 1996)
16 Keeton W.P. *et al.*, eds (1984) *Prosser & Keeton on Torts* (5th edn), West Publishing, Minnesota, USA
17 Pizzirusso, J. (2000) Increased risk, fear of disease and medical monitoring: are novel damage claims enough to overcome causation difficulties in toxic torts? *Environ. Lawyer* 7, 183–197
18 *Ayers v. Jackson Township*, 525 A.2d 287 (N.J. 1987)
19 *In re Paoli R.R. Yard PCB Litigation*, 35 F.3d 717 (3rd Cir. 1994)
20 *Daubert v. Merrell Dow Pharms., Inc.*, 509 U.S. 579 (1993)

CAOPLC Exhibit

Data Request CAOPLC-01
Dated: 06/30/2009
Q-CAOPLC-003
Page 4 of 4

MAGNETIC FIELDS FOR A 345-kV DELTA LINE CONFIGURATION WITH 1000-AMPERE LINE CURRENT



CAOPLC Exhibit 4

Perceived Risks of EMFs and Landowner Compensation

Linda J. Orel*

Introduction

After settling into your dream home, you read in the newspaper that overhead, high voltage power lines will soon run through your back yard. You may recall stories about children living near power lines and be afraid of possible dangers from electromagnetic fields (EMFs). Also, regardless of personal concern, you may worry that any remaining land will lose value because others fear EMFs.

Scenarios like this are increasingly common throughout the country.1 Media speculation about studies showing a positive correlation between EMF exposure and cancer has caused public fear2 among residents of more than one million homes living near power lines. Whether EMF exposure poses serious health risks remains scientifically unsettled,3 but property values continue to decline and landowners continue to seek compensation from electric utilities.

Electromagnetic Fields

EMFs are invisible forces that exist wherever there is electric power4 and are emitted from almost all electrical devices. They are, in varying magnitudes, present in virtually every home, office and school in the industrialized world. Although field strengths drop dramatically with distance from their source,5 EMFs from high-voltage power lines may be significant at distances over 300 feet.6 The scope of the potential problem is underscored by the fact that 642,000 miles of power lines dangle across the U.S.7

Several epidemiologists have addressed whether EMF exposure8 causes a larger than expected number of people to get cancer.9 In 1992, Swedish epidemiologists made international headlines with the first definitive showing that cancer rates rise with increasing EMF exposure.10 Yet, a 1994 Canadian-French study analyzing thousands of electric utility workers did not replicate the Swedish results.11

Beyond doubts arising from such conflicts, scientists also point out that statistical correlations do not, alone, establish causation.12 They claim that laboratory or clinical research are more convincing.13 Such researchers,14 have demonstrated that EMFs affect biological systems but are unsure whether they are dangerous.15 While the scientific debate remains unresolved, possible health effects of EMF exposure have far-reaching and growing implications.16

Eminent Domain

The 5th Amendment to the U.S. Constitution and most state constitutions require "just compensation" whenever private property is taken for public use.17 Actions initiated to take title to private land for public purposes involve the law of eminent domain.

According to the U.S. Supreme Court, application of the 5th Amendment is not limited to direct acquisition of private property. Owners may also recover when government action substantially interferes with rights and interests.18 Also, the Court has held that statutes that regulate or affect land use may constitute takings of property.19

There is no set formula for what constitutes a taking. Courts look at the character of the governmental action including economic impact -- particularly the extent to which the action substantially interferes with property owners' "reasonable investment-backed expectations."20

Governments take property for public purposes through condemnation proceedings that award landowners' its fair market value and any loss in value to their remaining property.21 For example, if a public utility severs a strip of land to build high-voltage power lines, the value of the remainder is negatively affected because few buyers would want to be exposed to EMFs.22 Thus, an owner can be awarded severance damages in addition to the value of land actually taken.

Three Approaches

In response to a growing number of proceedings against electric utilities, the courts have adopted three basic approaches in EMF cases.23 Those, here described as taking a "conservative" approach, require a plaintiff to show not only that fear of EMFs affects property values, but also that such fear has a solid foundation in scientific fact. Others, taking a liberal approach, require a mere showing that the public's fear is affecting land values whether reasonably based, or not. Between these is an intermediate approach under which plaintiffs may recover if they can show that fear of power lines is reasonably based even though a link between EMFs and personal injury has not yet been accepted by many scientists.

Conservative View

The most conservative courts reason that fear of power line exposure is grounded in superstition and that purported danger from power lines is too remote and speculative to be measured by a jury. This approach is illustrated by Alabama Power v. Keystone Lime,24 a 1914 condemnation proceeding regarding land selected for transmission lines. There the court found no right to compensation because of future buyers' potential fear of exposure to power lines.25 However, cases exemplifying this view were decided before concerns about EMFs became as widespread or legitimate. Recent epidemiological evidence and laboratory research may now cause those courts to respond differently. Indeed, Florida did so in 1987,26 but Alabama and Illinois have yet to follow.27

Intermediate View

Other courts may award damages if plaintiffs can prove that fear of EMFs is reasonable and affects property values. Hence, plaintiffs may have to show that knowledge of potential dangers of EMFs is widespread and reasonable based on highly publicized epidemiological evidence. Also, to prevail they must introduce market evidence showing a decline in property values. If both elements are proven, they may be awarded severance damages.28

Willsey v. Kansas City Power & Light29 is illustrative. The court affirmed a ruling that landowners may be compensated if the public's reasonable fears are the basis for damages.30 It set forth a three-part test, originally employed in Texas,31 to determine whether fear is reasonable. The court stated that:32

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....

Before being overturned in 1993 by the New York Court of Appeals, Zappavigna v. State of New York33 was the leading case that adopted the intermediate view. In Zappavigna, 50 separate landowners brought action against the State of New York which was acting pursuant to its power of eminent domain on behalf of New York State Power Authority. The State obtained a 250 foot wide strip of land running 3,100 feet along the property of one plaintiff, Zappavigna, to construct a transmission line.34 Zappavigna was awarded $53,352 for damages and $41,215 for severance damages arising from the partial taking of his property.35 During the trial, Zappavigna asserted that the remaining property value diminished as a result

of cancerphobia.36 The Court denied recovery and stated that the claimant would need to prove it more likely than not that a potential buyer had reasonable grounds for fear of EMFs and that the fear actually affected the market value of the property. The Appellate Court affirmed and held that compensation "must be based upon the opinion of experienced, knowledgeable expert or actual market data showing reduction in value of the remainder."37

Liberal View

A leading case describing the third view is San Diego Gas & Electric v. Daley.38 There, a utility sought to condemn property to obtain a 200 foot wide easement to construct overhead transmission lines.39 Taking the position that the issue was not whether EMFs caused health hazards, but whether the fear of danger affected the property's market value, the trial court admitted testimony of a civil engineer40 and a real estate appraiser concerning EMFs and depressed market value. The jury awarded $190,000 for the condemned property and $1,035,000 for the diminished value to the remainder.41 San Diego Gas & Electric appealed, but the verdict was affirmed, with the appeals court stating that severance damages "can be based on any indirect factors that cause a decline in the market value."42 The plaintiff "should be compensated for any characteristic of the project which causes an adverse impact on the fair market value of the remainder."43 The size of the award for loss in value to the remainder shows the potential for substantial adverse impact.

In 1993, the New York Court of Appeals adopted this view in Criscuola v. State of New York,44 an appeal by one of the plaintiffs in the earlier discussed Zappavigna case. In concluding that whether the danger is a scientifically genuine should be irrelevant to the central issue of its impact on market value,45 the court noted:46

To add the extra component of reasonableness... because the condition may not be something within common knowledge of experience... is not supportable or necessary. Thus... the public's or the market's relatively more prevalent perception should suffice, scientific certitude or reasonableness notwithstanding.

Thus Criscuola was awarded damages for the 6.5 acres he lost to the power line easement and for the diminution in value to the remaining 90 acres of his property.

At least thirteen states as well as the 5th and 6th U.S. Circuit Courts of Appeal have adopted this approach.47 These jurisdictions hold that landowners need only prove that public perceptions cause significant decrease in value: Whether the ultimate basis for a reduction in property values is reasonable is legally irrelevant, and scientific testimony about the grounds for these fears is inadmissible.48

Conclusion

As discussed, EMF cancerphobia has dramatically affected the value of property after condemnation regardless of whether scientists agree about the dangers of EMFs. Yet, a plaintiff's success may depend on where they file suit. Some courts may insist that public fears be reasonable or even that they be justified by scientific proof. Others, however, allow recovery when competent evidence shows that the market value of remaining land has plummeted. In these courts, scientific justification for any fear plays no role.

The last view seems to represent the best approach insofar as the actual loss to a plaintiff should be the only important question. That fear of EMFs could eventually prove to be objectively unwarranted is of little solace to landowners who now suffer loss in fact.

Someday, science may provide answers to the issues surrounding the possible danger of EMF exposure. Until then, the only fair solution is to compensate landowners for proven reductions in value of their

property. Also, plaintiffs' attorneys can foster this result by pleadings that avoid complex issues which, under the best of circumstances, may only confuse decision makers.

* Ms. Orel received a B.S. (Political Science and Speech Communication) from Northeastern University. She is a candidate for the J.D. at Franklin Pierce Law Center pursuing a special interest in environmental law.

1 This article does not address the rights of a party purchasing property near existing power lines.

2 Todd D. Brown, The Power Line Plaintiff & the Inverse Condemnation Alternative, 19 B.C. Envtl. Aff. L. Rev. 655, 655 (1992). See, e.g., Paul Brodeur, Calamity on Meadow Street, New Yorker, July 9, 1990, at 38.

People have also been concerned about aesthetics, radio and television interference and potential shocks. See, U.S. Congress OTA, Indira Nair, M. Granger Morgan & Keith Florig, Biological Effects of Power Frequency Electric and Magnetic Fields (1989).

3 See, Eileen N. Abt, Coping with the Risk of Cancer in Children Living Near Power Lines, 5 Risk 65 [1994]. Tort suits have alleged that EMFs caused childhood leukemia, brain cancer, lymphoma and breast cancer, but plaintiffs have difficulty proving causation. See, e.g., Kristopher D. Brown, Electromagnetic Field Injury Claims: Judicial Reaction to an Emerging Public Health Issue, 72 B.U.L. Rev. 325 (1992); Suit Seeks to Hold Two Utilities Liable for Injuries to Family Living Near Substation, 6 Toxics Law Rep. 927 (1992).

4 See, Edward Gerjuoy, Electromagnetic Fields: Physics, Biology and Law, 35 Jurimetrics J. 55 (1994).

5 Robert Pool, Is There an EMF-Cancer Connection? 249 Science 1096, 1097 (1990). See also, Special Epidemiological Studies Program, California Dept. of Health Services, Electric and Magnetic Fields: Measurements and Possible Effects on Human Health 1 (1992); Consumer Reports, Electromagnetic Fields, May, 1994, p. 354. The intensity of magnetic fields depends on the strength of the current and is commonly measured in units called milliGauss (mG).

6 U.S. Environmental Protection Agency, Questions and Answers About Magnetic Fields 3 (1992).

7 Amy Dana & Tom Turner, Currents of Controversy, 15 Amicus J. 29 (1993) (Concerning citizen groups' legal challenges to electric utilities' construction projects).

8 See e.g., Health Effects of Low Frequency Electric and Magnetic Fields, 27 Envt'l Sci. & Tech. 51 (1993). Nancy Wertheimer & Ed Leeper, Electrical Wiring Configurations and Childhood Cancer, 109 Am. J. Epidemiol. 273 (1979).

9 N.H. Div. of Public Health Services, Bureau of Disease Control, Cancer Clusters, What Are They and What Can be Done?

10 See, e.g., Richard Stone, Polarized Debate: EMFs and Cancer, 258 Science 1724 (1992).

11 See, e.g., Canada-France EMF Study Inconclusive, 264 Science 205 (1994).

12 The Environmental Protection Agency reported in 1991 that EMF exposure may be a factor in particular children's diseases. However, it called for further research because of insufficient and contradictory data. In 1992, the White House Office of Science and Technology Policy reached a similar conclusion; see Stone, supra note 10, at 1724.

13 Consumer Reports, supra note 5, at 356.

14 Brown, supra note 2, at 661.

15 See Questions and Answers, supra note 6.

16 See, e.g., Roy W. Krieger & Michael E. Withey, EMF and the Public Health, 9 Nat. Resources & Env't 3(1994).

17 Both state and federal constitutions give governmental entities power to act. Federal courts are courts of limited jurisdiction and may only hear cases that arise under the U.S. Constitution and federal laws, when the United States government is a party (e.g. a case against the military or a federal agency, etc.), or when there is a case between a state and a citizen of another state or between two different states. More often, challenges arise under the authority of a particular state's constitution or statutes and are brought under the general jurisdiction of a state court. Sometimes a plaintiff has a choice of forum between a state or federal court.

18 Penn Cent. Transp. Co. v. New York City, 438 U.S. 104, 104 (1978).

19 Pennsylvania Coal Co. v. Mahon, 260 U.S. 393, 395 (1922); See, e.g., Lucas v. South Carolina Coastal Council, 112 S.Ct. 2886 (1992); Thornburg v. Port of Portland, 376 P.2d 100 (1963); United States v. Causby, 328 U.S. 256 (1945); Richards v. Washington Terminal Co., 233 U.S. 546 (1913).

20 Penn Cent. Transp., 438 U.S. at 120.

21 If property is essentially taken for public purposes without condemnation, a land owner may also bring an action for inverse condemnation.

22 See, e.g., Ann Bostrum et al., Preferences for Exposure Control of Power-Frequency Field among Lay Opinion Leaders, 5 Risk 295, 296 (1994):

Although most subjects were moderate in their beliefs..., [o]verall, subjects appeared to favor field limitation measures that could entail significant investments, especially for new sources.

23 Also, Congress and legislative bodies at the local and state levels have proposed or enacted laws to regulate the future location and configuration of new power lines.

24 Alabama Power Co. v. Keystone Lime Co., 67 So. 833, 835-37 (Ala. 1914).

25 Id.

26 Florida Power & Light Co. v. Jennings, 518 So.2d 895 (Fla. 1987).

27 See, e.g., Cent. Illinois Light Co. v. Nierstheimer, 185 N.E.2d 841 (Ill. 1962); Pappas v. Alabama Power Co., 119 So.2d 899 (Ala. 1960); S. Elec. Generating Co. v. Howard, 156 So.2d 359 (Ala. 1963).

28 See, e.g., M. Robert Goldstein & Michael J. Goldstein, Condemnation and Tax Certiorari, N.Y.L.J., January 28, 1993, at 3, (col. 1). See also, e.g., Dixie Textile Waste Co. v. Oglethorpe Power Corp., 447 S.E.2d 328 (Ga. Ct. App. 1994) (court excluded expert testimony regarding fear of power lines because landowner failed to show how the impact of general, public fear on value of remaining property could be calculated with reasonable certainty but allowed testimony showing variations in sales prices in property located adjacent to power lines and awarded damages) or Selective Resources v. Superior Court, 700 P.2d

849 (Ariz.Ct.App. 1984) (allowing recovery if the plaintiff can establish that a "mythical" buyer would have knowledge of all factors that may affect the value of property remaining after condemnation).

29 Willsey v. Kansas City Power & Light, 631 P.2d 268 (1981).

30 Id. at 270.

31 Heddin v. Delhi Pipeline Co. 522 S.W.2d 886 (Tex.1975).

32 Id. at 888. See, e.g., S. Indiana Gas & Elec. Co. v. Gerhardt, 172 N.E.2d 204 (1961); Colvard v. Nantahala Power & Light Co., 167 S.E. 472 (1933); Oklahoma Gas & Elec. Co. v. Kelly, 58 P.2d 328 (1936); Appalachian Power Co. v. Johnson, 119 S.E. 253 (1923).

33 Zappavigna v. New York, 588 N.Y.S.2d 585 (N.Y.App.Div. 1992), overruled by Criscuola v. New York, 621 N.E.2d 1195 (1993); See also, Miller v. New York 458 N.Y.S.2d 973 (1982).

34 Roy A. Torres, Causes of Action for EMF Harm, 5 Fordham Envtl. L.J. 403 (1994) (citing Zappavigna v. State & Power Auth. of New York, slip. op. at 12, 30-31 (N.Y.Ct.Cl. Sept. 29, 1989)).

35 Id.

36 Zappavigna v. New York, 588 N.Y.S.2d 585 (N.Y.App.Div. 1992) at 586.

37 Id. at 588.

38 San Diego Gas, 253 Cal.Rptr. 144.

39 Id. at 147.

40 Id.

41 Id. at 145.

42 Id. at 150.

43 Id.

44 Criscuola, 621 N.E.2d 1195 (1993). See also, Gary Spencer, Court Allows Damages for Fear of Cancer, N.Y.L.J., Oct. 13, 1993, at 1, (col. 3) and Damages Allowed for Owners of Houses Near Power Lines, Boston Globe, Oct. 13, 1993, at 11.

45 Criscuola, 621 N.E.2d 1195.

46 Id. at 1197.

47 Id. See, e.g., Meinhardt v. Kansas Power & Light Co., 8 Kan.App.2d 471 (1983); State v. Evans, 612 P.2d 442 (1980), rev'd on other grounds, 634 P.2d 845 (1981). Claiborne Elec. Coop., Inc. v. Garrett 357 So.2d 1251 (La.Ct.App. 1978), cert. denied, 359 So.2d 1306 (La. 1978); Basin Elec. Power Coop., Inc. v. Cutler, 217 N.W.2d 798 (S.D. 1974); T.V.A. v. Easement & Right of Way, 405 F.2d 305 (6th Cir. 1968); United States ex rel. T.V.A. v. Rovertson, 354 F.2d 877 (5th Cir. 1966); Ohio Pub. Serv. Co. v. Dehring, 172 N.E. 448 (1929); Evans v. Iowa Util. Co., 218 N.W. 66 (1928).

48 Philip S. McCune, The Power Line Health Controversy: Legal Problems and Proposals for Reform, 24

U. Mich. J.L. Ref. 429 (1991). See also, San Diego Gas & Elec. v. Daley, 253 Cal.Rptr. 144 (Cal.Ct.App. 1988).

Top of page
Risk Articles Index

CAOPLC Exhibit 5

For over a century electrical transmission systems have been based mainly on overhead transmission lines (OHL). The main reason for this has been the cost advantage when compared to high-voltage underground transmission.

Recent studies suggest the cost premium of underground transmission is in the range of 5–15 times the traditional overhead transmission alternative. But this comparison is already dated. Two main factors are affecting the paradigm:

- Environmental restrictions are increasing the costs and implementation time for overhead transmission.
- Technological development significantly reduces the cost of underground transmission.

Consequences of environmental restrictions

There are several reasons why underground HVDC cables have a better environmental profile than overhead HVAC lines.

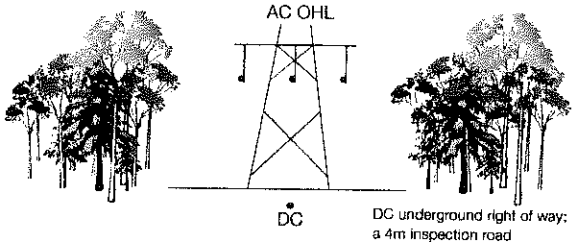
Land use

An HVDC cable uses significantly less land than an overhead HVAC line. The right-of-way for a 400 kV OHL can be a 60 m wide strip where no buildings/high trees are allowed whereas an underground DC cable needs at most a 4 m wide inspection road on top of it. For AC OHL the amount of land required for a 400 km transmission is 2,400 hectares (1 hectare = 10,000 m²). However only 160 hectares are required for DC cable (< 6 percent).

Audible noise

Restrictions on land use stretch beyond the immediate right-of-way. Audible noise from transmission line corona – most noticeable when conductors are wet in foggy weather conditions – might restrict buildings close to OHL. The width of this "noise corridor" depends on local noise ordinance as well as on the design and voltage of the line. Noise objections from neighbors make it more difficult to obtain permits. An underground DC cable naturally has no audible noise emission.

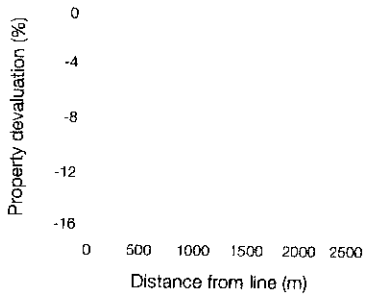
Land use comparison for HVDC Light® and AC OHL transmission.



EMF

Magnetic and electrical fields can also restrict the use of land close to an OHL. In several countries a precautionary policy vis-à-vis magnetic fields is in force. The Swedish National Electrical Safety Board and the Dutch Ministry of Housing and Environment both suggest a 0.4 μT safety level for 50 Hz magnetic fields from transmission lines. This level corresponds to field levels normally encountered in city environments today. In contrast to an AC line, the field for a DC cable is static (non-radiant). Applying the same precautionary policy as for AC would not call for the provision of any "EMF corridor" around an underground DC cable. The field immediately above the cable is far less than the earth's natural magnetic field.

Effect of proximity of overhead line on property values (in Finland).



Comparison of material usage

Material	DC underground	AC OHL
Aluminium	3.3 kg	2.1 kg
Copper	1.4 kg	
PVC	2.3 kg	
PEX	6.1 kg	
Steel		100.0 kg
Ceramics		0.3 kg
Concrete		376.3 kg
Total	**13.1 kg**	**478.8 kg**

Right-of-way as a loss of CO_2 sink

Growing forests are considered CO_2 sinks because trees convert carbon dioxide from the atmosphere into carbon stored in the form of wood and organic soil matter. A forest can absorb 9.2 tons of CO_2 per hectare per year. Building a 400 km, 400 kV overhead transmission line through an area that is 75 percent forest represents a loss of a carbon sink of 16,780 tons of CO_2 per year.

HVDC Light® technology was introduced in 1997 with a small test installation of 3 MW. Since then, both cables and converters have progressed dramatically in both size and performance.

Material use

The material intensity of an AC OHL is higher than a DC cable. The statistical material use per meter of transmission is compared in .

Using lifecycle assessment (LCA) to analyze the "cradle to grave" material impact, the DC cable has an environmental impact of 64.5 kg of CO_2-equivalents per meter and the AC OHL has an impact of 365.4 kg of CO_2-equivalents per meter. In other words, the material used in the DC cable has only 17.6 percent the environmental impact of the AC OHL.

Aesthetics – Property value

Several studies have shown that property values are reduced close to OHL. For example, a study carried out in the United Kingdom showed the value of detached properties a distance of 100m from OHL were 38 percent lower than comparable properties. A Finnish study showed that the reduction is proportional to the distance from the line .

Assuming that every 500m along the 400 km line there is:

- One property 500m from the OHL (with 8 percent value reduction).
- Two properties 1000m from the OHL (with 4 percent value reduction).
- Three properties 2000m from the OHL (with 2 percent value reduction).

If an average property is valued at $150,000, the reduction in property value along the 400 km OHL then amounts to a staggering $25 million.

Electrical losses

When HVDC Light® underground transmission is used inside an AC-grid, the transmission system can be operated in a more optimal way leading to lower electrical losses. The losses in the HVDC line are equivalent to the loss reduction of the AC grid, ie, the HVDC line is considered to transmit electricity "without" losses. The more efficient operation of a transmission system with HVDC can be attributed to two causes: the average higher voltage level in the AC grid and the reduction of reactive power flows.

For example, on a 350 MW transmission (50 percent utilization) there are no HVDC losses whereas HVAC losses amount to 5 percent. This means the operator has 76,650 MWh more electricity to sell each year with an HVDC connection.

The overall electrical losses[1] can be translated into 45,990 tons of CO_2 emitted per year.

Power system stability

HVDC systems can never become overloaded, and they offer additional benefits through their ability to control power flow and voltage . HVDC can be very effective in damping power oscillations, as well as avoiding or limiting cascading system disturbances, particularly when connecting two points inside the same AC-grid, ie, in parallel with AC-lines: an HVDC Light® converter is excellent at generating or consuming reactive power.

Technical characteristics of underground transmission system

When planning traditional overhead transmission lines, it is better to choose high voltage lines for transmission over large distances because not only can transmission capacity be increased but losses are also reduced. However, for AC transmission in underground cables the situation is somewhat different. If the voltage is increased, the reactive power absorption of the cable increases so that its technical maximum length is reduced rather than increased. The laws of physics in this case then work against long AC transmission. Today's experience of cable transmission suggests a maximum transmission distance of about 60km for a 345kV AC underground cable.

Reasons why underground HVDC cables have a better environmental profile than overhead HVAC lines include land use, audible noise, EMF, material use, and power systems stability.

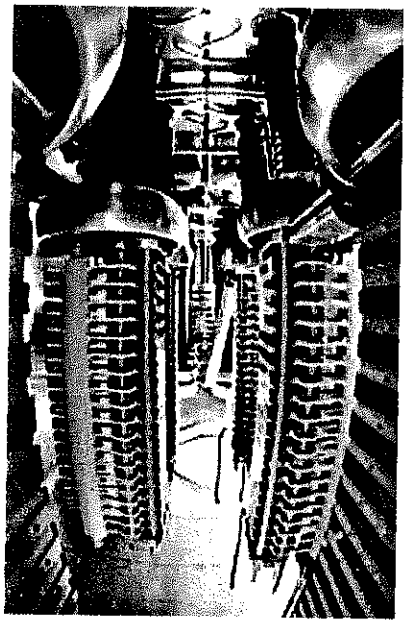
HVDC Light®, a new transmission system designed for underground transmission

This technology is based on some key components:

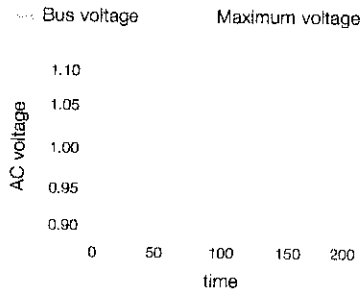
- Extruded cable technology
- Converter technology
- Control and protection technology

Voltage source converters cause less stress on the cables than conventional HVDC converters and this has enabled the development of extruded cables for HVDC. The extruded cable has some significant advantages over traditional mass impregnated cables. It:

- Is completely oil free.
- Has low weight.
- Is very flexible and this simplifies handling during installation.
- Has very simple prefabricated joints.



HVDC improves the stability of AC networks.



HVDC Light® product matrix.

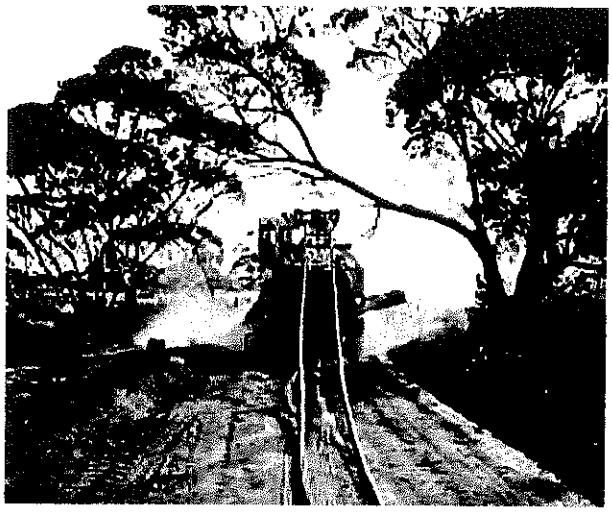
Available 2000
Available 2004
Available 2006

DC Voltage	500 A	1000 A	1500 A
+/- 80 kV	90 MW	180 MW	280 MW
+/- 150 kV	170 MW	350 MW	500 MW
+/- 300 kV	350 MW	700 MW	1000 MW

Footnote

[1] Using the OECD average of 600 kg CO_2/MWh for electricity.

Construction of Murraylink HVDC Light® (Australia).



Voltage source converters also show significant advantages over traditional HVDC converters such as:

- Dramatically smaller size. Typically they are half the height and their footprint is 25 percent smaller.
- Superior voltage and reactive power control reduces the risk of blackouts.
- They act as a "firewall" for network disturbances and block the cascading trips that occur in AC systems[2].
- They can operate in very weak networks and do not require network reinforcements.
- They reduce down time after outages with their "black start" capability.

New high-speed control and protection technology makes it possible to fully utilize the inherent benefits of the voltage source converters.

Technical development of HVDC Light® systems

HVDC Light technology was introduced to the market in 1997 with a small test installation of 3 MW. Since then, both cables and converters have progressed dramatically in both size and performance. Today the largest system in service is a 330 MW system operating at ±150 kV. A 350 MW system is currently under construction. The converter design has been refined by the adoption of new switching schemes that reduce the number of components and cut the converter losses by 60 percent.

In contrast to traditional HVDC, an HVDC Light® system is highly modularized and makes greater use of semiconductors. The product matrix shown in ▣ highlights available modules.

Increased environmental pressure on overhead transmission lines is both raising total costs and increasing the risk for substantial project delays.

Cable installation techniques

A crucial element in underground transmission is the cable installation technique. In the Murraylink project in Australia, ▣ and ▣, a very successful installation was implemented using modified pipeline installation equipment. Up to 3 km of cable was successfully installed per day. The total cost of laying the 170 km cable system amounted to the very reasonable sum of about AU$ 10 million ($7.6 million). HVDC Light cables have relatively low weight (typically < 10 kg/m), making its installation similar to that of fibre-optic cables: the equipment used for trenching and the depth at which the cables are laid is comparable (1 to 1.5 m below the surface).

Cost comparison Overhead lines – Underground transmission

The new HVDC technology has, as already mentioned, some unique characteristics particularly when it comes to increasing network security. This means before a strict cost comparison is performed, a needs evaluation is required. Some key checkpoints are listed in ▣.

▣ HVDC suitability checklist

- ☐ Need for power transmission 50–1000 MW
- ☐ Need for accurate and fast control
- ☐ Distance more than 100 km
- ☐ Difficult to obtain permits for OHL
- ☐ Asynchronous networks
- ☐ Weak AC network
- ☐ Risk for dynamic instability
- ☐ Power quality issues
- ☐ Need for grid black start capability
- ☐ Need for high availability although occurrence of thunderstorms, wind storms/hurricanes or heavily icing conditions may apply
- ☐ Need for low maintenance
- ☐ Need for small footprint
- ☐ Risk of low harmonic resonances
- ☐ Need for fast voltage an reactive power control to enhance network security

Footnote

[2] See "HVDC: A 'firewall' against disturbances in high-voltage grids", Lennart Carlsson, ABB Review 3/2005 pp 42–46.

If at least three of these conditions are fulfilled it is likely that an HVDC Light® system will offer a very attractive solution. If, however, OHL permits are difficult to obtain, then this reason alone is sufficient to warrant an HVDC Light® solution.

In the following paragraphs, two examples currently being studied are presented.

Case 1,700 MW over 400 km

It is assumed this case fulfils at least five of the criteria outlined in [illegible], such as:

- The need for 50–1000 MW.
- Transmission distance is greater than 100 km.
- Difficulty to obtain permits for OHL.
- Risk of dynamic instability.
- Need for fast voltage and reactive power control to enhance network security.

A comparison of the direct investment cost shows the following span:
The direct investment cost for HVDC Light® option including converters, cables and their installation is in the range of $275–$420 million. The breadth of this range is primarily due to differences in installation costs and local market conditions.

For the AC overhead option there is an even greater span in cost. A study made by ICF consultancy in 2001 shows a huge variation in costs from country to country. Using these data, the direct investment cost for the AC overhead option gives a cost range of $130–$440 million for the line including installation and substations.

At the direct investment cost level the price for the underground alternative is between 0.6 and 3.2 times the overhead option. This is quite a difference from the normally anticipated 5–15 times.

Furthermore, other factors should also be considered, for example:

- Additional investments in equipment to manage voltage and reactive power control in the AC case.
- Losses (both cases).
- Costs for permitting the overhead solution.
- Cost for permission and construction time (both cases).
- Increased transmission capacity in the existing AC grid (HVDC case).
- Loss of property value.

When these factors are included in the evaluation, the competitiveness of the HVDC alternative increases. Assume, for example, the following realistic additional factors for the overhead option:

- Additional reactive compensation: $25 million.
- Loss of property value: $25 million.
- Value of increased transmission capacity in existing AC grid: $50 million.

Applying these factors raises the price tag of the AC alternative to between $230 million and $540 million, and that of the underground option to between $275 million and $420 million. The costs of the two alternatives are quite comparable and local factors determine which option is the most advantageous.

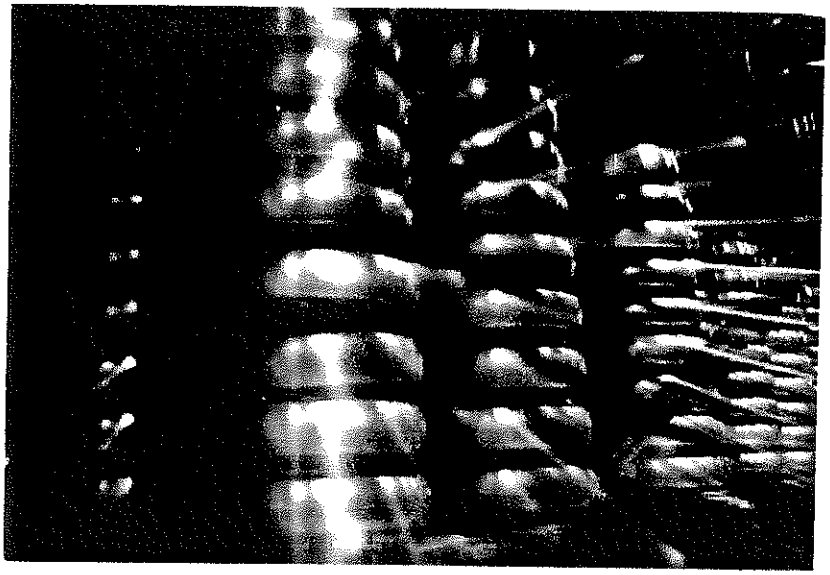
Case 2,350 MW over 100 km

A similar exercise for this case results in a direct investment cost for the HVDC option of between $110 million and $150 million, whereas the AC overhead version costs vary between $40 million and $90 million. The relative direct investment cost of the HVDC solution is in the range of 1.2–3.75 times that of an OHL. The application of the additional factors discussed above will again reduce the cost difference between the alternatives.

Conclusions

Increased environmental pressure on overhead transmission lines is both raising total costs and increasing the risk for substantial project delays. New HVDC technology in the form of HVDC Light® has made underground options technically feasible and economically viable. This is especially so if the new grid investment is driven by security of supply issues. The conventional view that an underground link will cost 5 – 15 times its overhead counterpart must be revised. Depending on local conditions, it is realistic that the costs for an underground high-voltage line are equal to that of traditional overhead lines.

[illegible] HVDC Light® valve.



Dag Ravemark
ABB Corporate Research
Västerås, Sweden
dag.ravemark@se.abb.com

Bo Normark
ABB Power Technologies
Zürich, Switzerland
bo.normark@se.abb.com

CAOPUC Exhibit 6

Print

November 9, 2007

Creating a 21st Century Grid

by Stephen Lacey, Staff Writer
Peterborough, New Hampshire [RenewableEnergyAccess.com]

In 1957, as Eisenhower began his second term as U.S. President, the first satellite launched into orbit and the first commercial nuclear reactor came online, electrical workers all over the country were installing the world's most advanced transmission and distribution (T&D) system. Today, much of that T&D system installed 50 years ago remains in place, holding together a patchwork grid for ever-expanding electricity markets.

Now in 2007 – the age of the internet, personal digital media and distributed energy — the grid has failed to keep pace with the rapidly changing technological landscape. While most industries rely on technologies that have been invented or updated in the last few years, the electricity delivery industry uses technologies that have more or less stayed the same for 100 years.

There's a common idiom that goes, "if it ain't broke don't fix it." While the grid in the U.S. is hardly broken, it is beginning to deteriorate rapidly in some places, and it will need some serious repairs in order to meet the growing demand for electricity in general and distributed renewable electricity specifically.

"We need to see a very substantial transformation of the system," says David Meyer, Senior Policy Advisor in the Office of Electricity Delivery and Energy Reliability at the U.S. Department of Energy (DOE). "We're outgrowing it in many parts of the nation. It's certainly not the high-capacity, integrated and smart system that we need."

The current grid is a stiff arrangement of one-way transmission lines, centralized generation facilities and aging substations. The recent emergence of large amounts of renewable electricity in markets around the country are creating new challenges for both the transmission and distribution sectors.

On the transmission side, the issue is whether there are enough lines to bring renewable energy onto the grid. Because many of the abundant renewable resources are far away from load centers, additional lines must be built to bring wind, solar and geothermal energies to market. If plans to construct lines are not on the table, developers will be hesitant to build large projects in these rural areas.

"This is what we call the 'chicken and egg' problem," says Meyer. "It's difficult to develop new generation without being certain that the transmission capacity is there or will be there. No one wants to be out front taking an undue portion of the risk."

As planners look to build more of those lines, they may have some emerging technologies to consider; particularly High Voltage Direct Current (HVDC) and wires based on nanotechnology.

HVDC transmission is certainly not a new concept — but it's gaining ground in the U.S. as renewable electricity will have to be transported further distances with higher efficiency in the future.

The other technology still in the research and development phase is the "armchair quantum wire," made from tubes of carbon 100,000 times thinner than a human hair, called carbon nanotubes. When these nanotubes are made into a larger wire, they can conduct electricity far more efficiently and over far greater distances than the copper wires used today.

A leading researcher of carbon nanotubes, Dr. Wade Adams of the Richard E. Smalley Institute for Nanoscale Science and Technology, says that these nanotube wires can theoretically conduct 100 million amps of current over thousands of miles without much loss in efficiency. Today's wires conduct around 2,000 amps of current over hundreds of miles, with about 6 to 8% of the electricity lost in the form of heat.

According to Adams, these armchair quantum wires will also be one sixth the weight of current wires and so

strong that they won't need support mechanisms. That means new transmission lines would be less conspicuous, and perhaps not as controversial to communities and interest groups concerned about their impact on the landscape.

"That enables us to carry, say, electrical power from vast solar farms in the desert to the Northeast, or maybe from wind farms in Montana or North Dakota down to Florida – and in fact, even from continent to continent," says Adams.

Of course, transmission lines made from carbon nanotubes are about 10-15 years away from commercialization. But if brought to scale, these new lines could transform how the nation, and indeed the world, transmits large amounts of renewable electricity.

The distribution sector, which is made up of facilities that lower voltage for ordinary consumption, faces a different set of issues. One of the biggest challenges for distribution is the emergence of smaller renewable energy generators, which can sometimes cause issues with metering and load flow. This is where the "smart" grid system comes in.

In order to better control electricity entering the grid at the local level, interactive control devices, monitoring networks, energy storage facilities and demand response systems will need to be implemented. As distributed generation becomes more widespread and local communities start generating their own power, the grid must adapt in order to handle a steady two-way flow of electricity.

"You have to think much more distributed than centralized, you have to solve the problem of storing energy, and it has to be much more like an internet system than the current grid is today in order to be effective," says Adams.

These upgrades of the T&D infrastructure won't be cheap and they won't happen quickly. According to the Electric Power Research Institute, a California-based energy think tank, the cost of upgrading the grid with "smart" technologies could be $100 billion. Some analysts have put the figure at around $150 billion. While utilities and other developers would pay for much of the upgrade, ratepayers and taxpayers would also be responsible for the bill.

However, the economic impact associated with a failed grid could rival the price of an upgrade. For example, the 2003 Northeast blackout caused an estimated $6 billion in direct and indirect economic losses over only a few days.

According to the North American Reliability Corporation's 2007 Long-term Reliability Assessment of the North American Grid released last month, transmission capacity continues to lag behind demand and will need to increase by more than 10% over the next 10 years to meet the needs of the U.S. electricity markets, especially as more states integrate renewables into their energy portfolios. The report also recognizes the imminent need to develop reliable storage capacity to better manage demand.

So in 2007, as we use the grid in ways it was not originally designed for, the energy community is looking for new ways to maintain the T&D infrastructure so that it doesn't just meet market needs, but reacts to them.

"There's a lot of awareness of the benefits associated with this kind of change. While we won't see the change overnight, I am very optimistic that we can implement these new technologies and make the grid far more sophisticated," says DOE's Meyer.

For Further Information

- http://www.renewableenergyaccess.com/rea/news/podcast?id=50508

Please Note: RenewableEnergyWorld.com does not endorse the sites behind these links. We offer them for your additional research. Following these links will open a new browser window.

http://www.renewableenergyworld.com/rea/news/article/2007/11/creating-a-21st-century-grid-50519

CROPLC Exhibit 7

State of Connecticut
GENERAL ASSEMBLY
STATE CAPITOL
HARTFORD, CONNECTICUT 06106-1591

June 23, 2004

Ms. Pamela B. Katz
Connecticut Siting Council
10 Franklin Square
New Britain, CT 06051

RE: Docket No: 272 – Middletown – Norwalk 345kV Transmission Line

Dear Ms. Katz:

The undersigned legislators applaud the Siting Council, ("Council"), for its wisdom in hiring an underground transmission expert to make an objective finding as to the maximum feasible length of underground constructing of the transmission lines. It is our understanding that this expert will be acting on behalf of the Council to aid the Council in working to determine the reliability of the undergrounding of the 345kV electric cables. The hiring of this expert is an effort by the Council to evaluate the claims by Northeast Utilities that underground transmission wires could only be underground for a short distance while some believed, based upon European Countries, longer distances could be achieved without risking reliability. Additionally, the signatories understand that the expert hired by the Council would have the knowledge and skill to review the Northeast Utilities plans as well as the ability to investigate the Northeast Utilities plans for maximizing the placing of the transmission lines underground.

We have become concerned by recent reports that the expert may only be reviewing research and studies supplied by Northeast Utilities. And, further that the expert will not be given the authority to conduct his/her own independent testing and investigation in order to make the required evaluation.

Given the recent pre-filed testimony of ISO, our concerns have grown. ISO reviewed two studies sanctioned by Northeast Utilities regarding the burying of underground power lines. As you are aware, based upon this report information supplied by Northeast Utilities, ISO came to the conclusion that the power lines cannot be buried for a substantial distance, which conclusion directly conflicts with the Applicant's own testimony on the subject. As a result, ISO's conclusion as to the amount of transmission lines that can be buried raises more issues than it solves. ISO's conclusions are based upon certain assumptions and certain findings all of which were contained in a report furnished by Northeast Utilities. It is our hope that the Council's expert will be given both the time and resources to conduct a full and meaningful investigation into the feasibility of maximizing the burying of the transmission cables. The above is critical to ensure fairness and balance to this process.

Obviously, this issue is an utmost concern to our constituents. Public policy would require an objective expert who do more than merely review studies furnished by the applicant. The outcome of such a review is almost a foregone conclusion and would substantially undermine confidence in the process being applied to this application. We hope that your independent expert will obtain the most unbiased empirical data, which would enable the expert to take a definitive and truly independent position on issue of reliability of buried transmission cables.

Therefore, the undersigned bipartisan legislative group requests this Council to authorize the expert to perform any test, any research and/or to take whatever steps are necessary to accomplish the goal of advising the Council as to the maximum length or area the power lines can be buried. If there is a budget issue concerning the expert, please let us know.

We look forward to the Council's response to this letter.

Win Smith, Jr.
Senator, 14th District

Len Fasano
Senator, 34th District

William Aniskovich
Senator, 12th District

Joe Crisco, Jr.
Senator, 17th District

Themis Klarides
Representative, 114th District

Jim Amann
Representative, 117th District

Al Adinolfi
Representative, 103rd District

CAOPLC
Exhibit 8

EU directive on cell phones and masts expected

tugal News has obtained a copy of a confidential document outlining the details of an EU ation into the health dangers caused by radioactive electromagnetic fields (EMF's) generated le phones, telephone masts and electricity pylons. It will be of special interest to the many who during the past few months have contacted our offices to complain about masts and hat have been built close to their homes and schools. MAIN - 22/03/2003

The document coincides with a decision by the world's largest insurance body, Lloyds of London, to refuse insurance cover to cell phone and power generating companies against damage to workers and consumers' health. It also comes at a time when the Dutch Parliament has called for an urgent investigation into the health dangers posed by EMF emissions.

A meeting of the European Employment, Social Policy, Health and Consumer Affairs Council (ESHCAC) took place on March 6th. The ESHCAC has appointed a working party to look into the findings of a meeting of radiation experts held in Luxembourg last September. The Danish and Greek governments have called for these findings to be included in an EU Directive concerning safety limits on EMF emissions.

As far back as 1992 concerns were growing regarding radiation emissions in the workplace and residential areas. It was at this time that the Commissioners requested that the Council of Ministers issue a directive on the minimum requirements for workers who are being exposed to noise, vibration and EMF's. The council subsequently issued a directive on noise and vibration but chose to deal with radiation as a separate issue.

It is anticipated that the question of EMF's will be included in the forthcoming meeting of EU ministers scheduled for next June. But in a confidential communiqué, a copy of which has been obtained by The Portugal News, Luis Amorim, Press Officer for the Council of the European Union, has informed a London based freelance journalist, that any firm decision to set legally binding EMF emission limits will not come into force until mid 2004.

The present recommended international safety limits of EMF emissions are considered by many experts as being far too high. Research by American and Swedish scientists has shown that these limits are forty times higher than is otherwise safe. A major concern for campaigners against radiation pollution is that the EMF levels set by the EU Directive will fall in line with the existing unsafe international safety limits. This would do no more than protect power suppliers and cell phone companies from prosecution.

But Les Wilson, Managing Director of the radiation shielding company Microshield Industries, told The Portugal News that the EU initiative is a step in the right direction. According to Mr. Wilson once the EU Directive becomes law it would then be up to pressure groups and scientists to continue to lobby the EU Commissioners to reduce these limits to levels that have already been scientifically proved to be safe.

He recommended that EU member states follow the example of Spain, where the judiciary has ruled that exposure to EMF emissions is an infringement of an individual's human rights. The burden of proof has been firmly placed on cell phone and power suppliers to prove that radiation levels produced by telephone masts and electricity pylons are not a health hazard. The ruling has already led to hundreds of masts and pylons being removed from residential areas.

But until this happens Wilson said he would continue in his campaign to have masts and pylons removed from residential areas as well as hospitals and schools.

CAOPLC Exhibit 9

The Middletown Press (**middletownpress.com**), Serving Middletown CT and surrounding areas

News

5 settle suits over CL&P line work

Tuesday, July 14, 2009

By LUTHER TURMELLE, Journal Register News Service

Three area families reached a settlement Tuesday in lawsuits against Connecticut Light & Power Co. over the utility's handling of the Middletown-to-Norwalk power line upgrade, which was put into service in December.

The undisclosed monetary settlement in the case brought by two former Orange residents, a Milford couple and a Durham man came just hours before the lawsuits, which were combined into one case, were scheduled to be heard by a jury in Superior Court in Waterbury.

After meeting with attorneys for both sides, Judge Barry Stevens announced the settlement, which included a confidentiality agreement regarding the terms of the deal reached between the plaintiffs and the utility.

All of the lawsuits contended that CL&P overstepped certain rights given to it in a 1924 easement agreement signed when the power lines were first erected.

All of the plaintiffs own property that comes with an easement allowing utilities access to the power lines.

One of the lawsuits dates from March 2007 and was filed by Georgianna Passariello and her husband, Clement, former Orange residents.

"We were prepared to go to the mat with this," Georgianna Passariello said after the settlement was announced. "We felt we had been wronged, but obviously CL&P felt they were right, until the very end."

The Passariellos lived on High Plains Road in Orange until they moved to Litchfield County in 2006. They sued the utility, claiming CL&P had abused the power line easement by creating a gravel road on their land and uprooting trees, which reduced the value of their property.

The Passariellos and the other plaintiffs — William Korzon of Durham and Margaret and Joseph Farina of Milford — were represented by New Haven lawyer Benson A. Snaider, who declined comment on the settlement. But while this case nearly went to trial — a jury had already been chosen after a five-day selection process — Georgianna Passariello said at least a half dozen of Snaider's clients had settled their cases long ago.

"There were a lot of settlements," she said. "And I'm sure there was a lot of ratepayer money going to those who settled."

Mitch Gross, a CL&P spokesman, confirmed Tuesday's settlement, but declined to say how many other cases the utility had settled and at what cost.

Korzon's lawsuit was initially one of 10 filed by Durham families in 2007. He was not in court Tuesday, and it is not

known how many of his fellow Durham residents had previously settled.

Margaret Farina was visibly upset at the last-minute decision by CL&P to settle the case. "I'm not very happy about any of this," she muttered during the court proceedings.

Luther Turmelle can be reached at **lturmelle@nhregister.com** or (203) 789-5706.
