

ENVIRONMENTAL PROTECTION for CHILDREN TRUST

-----Original Message-----

**From:** PW.DM.WARD [mailto:PW.DM.WARD@xtra.co.nz]

**Sent:** Monday, 14 February 2005 4:00 p.m.

**To:** Electricity

**Subject:** Submission

Please acknowledge receipt.

I would also like the following submission to be taken in regard to Regulation of Electricity Lines Businesses - Implementing valuation choice for system fixed assets (draft decisions and discussion paper) and Review of the Information disclosure regime discussion, as the implications apply to both, particularly the provision to purchase land and houses beneath high voltage transmission lines and relocate them and for future holdings of land for future hvtl paths and "Power Corridors" also for the costs and profits with carrying other frequencies along the network. I would also like to see a full and frank discussion on line loss and the view on other options such as the aluminium cable mentioned below and discussion re the KYOTO protocol, particularly when the National Archive holds MED papers that specifically state that the most economical power production/generation is in close proximity to consumption so trucking it via hvtl and beneath the cook strait from one end of the country to the other or for that matter any great length of distance is inefficient/non-sustainable and seemingly going against the Kyoto protocol.

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Denise Ward, Christchurch, N.Z.

check out <http://canterbury.cyberplace.co.nz/ouruhia/>

and [www.neilcherry.com](http://www.neilcherry.com)

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----- Original Message -----

**From:** PW.DM.WARD

**To:** Electricity

**Sent:** Monday, February 14, 2005 2:52 PM

**Subject:** Submission on Regulation of Electricity Lines Business

Submission on Regulation of Electricity Lines Businesses, Targeted control Regime, Next Steps for implementing Proposed changes to the Distribution Thresholds.

Please acknowledge receipt of this submission.

I have made several submissions in the past for costing and provisions for "Power Corridors" - areas that exclude people living or working beneath high voltage transmission lines.

In the future litigation from people claiming their health may have been adversely affected due to the exposure to electromagnetic radiation from these high voltage transmission lines may be brought. Particularly because industry have been made aware of the possible adverse affects and research as have the National Radiation Laboratory and have chosen to disregard the evidence and have failed to take precautions or mitigate or remedy the effects. Recent litigation in the Chemical industry is setting a precedent for future litigation and it is clear where the final responsibility is resting.

More information is in the attached sub-re power corridor which was for another submission.

I would also like proper evaluation of the cost and profit for carrying other frequencies on high voltage transmission lines. Who will pay and rectify any damage to other frequencies (interference)? Who will advise the end user that their electricity may be "dirty"? Who will clean the end users power and pay for this?

The Christchurch Press recently carried an advertisement from an Indian firm stating it could offer these services. This recently in from Australia.

Broadband Over Power Line (BPL) (also called: Power Line Communications PLC), is a new technology that uses short-wave RF (1.7 to 80 Mhz + harmonics) pumped into the powerline grid so that residential and business people can simply connect to Broadband internet services.

There are a lot of problems with this system, especially interference with other

services but it is being actively promoted in Australia without acknowledging the problems, and ignoring others, such as possible health implications.

Now that there will soon be public submissions on this technology it is important that this issue gets some publicity in Australia. Simply, this technology may transform your home wiring into an antenna, your bedside lamp, electric blanket, etc etc all will be radiating an RF signal. This signal is of sufficient strength to cause interference with ham radio operators and this problem has caused some BPL trial systems in the US to be shut down.

The Australian Communications Authority (ACA) mentions the need to protect radio communications from harmful interference, but no one is mentioning the question of possible interference with human health being addressed. It may not be a health problem but until that possibility is addressed it will remain a public health issue.

According to a report prepared by the U.S. National Association for Amateur Radio, (ARRL) because power lines are not designed to prevent RF energy transmissions BPL represents a significant interference source for all radio services using this frequency range. Overhead power lines and residential wiring act as antennas that unintentionally radiate the broadband signals as short wave radio signals throughout entire neighborhoods [and homes] and along roadsides. Interference has been observed nearly one mile from the nearest BPL source.

From the ARRL report:

An April 27, 2004 report released by the National Telecommunications and Information Administration in the US found that current FCC Part 15 measurement techniques may "significantly underestimate" peak BPL field strength and that "interference risks are high under existing FCC Part 15 rules.

Although BPL proponents dispute these claims of interference to licenced services, they have provided little in the way of calculations or measurements of BPL radiation levels - and what they have provided has been flawed by technical errors. Until now, BPL systems have been limited to small, little publicised test areas. Even so, the number of complaints of actual interference is growing steadily and efforts to resolve them have had limited success.

See the article at <http://www.arrl.org/tis/info/HTML/plc/files/Barry.pdf> for a tutorial section that explains several BPL technologies.

I use broadband over telephone lines, which requires a filter to block out interference with telephone reception. No problems with RF in my home. However I do not like the idea of shortwave RF being broadcast from my home wiring. RF filters installed at the service drop may be a solution but who would have to pay for the expense of purchasing and installing them? An interesting legal question.

Also see: <http://www.arrl.org/tis/info/HTML/plc/> for a wealth of information on

## Broadband Over Power Line (BPL)

Broadband grid rules closer

<http://australianit.news.com.au/articles/0,7204,12006811%5e16123%5e%5enbv%5e,00.html>

Staff writers

JANUARY 21, 2005

THE communications regulator may soon seek public input on regulations for delivering broadband over powerlines. The Australian Communications Authority (ACA) said it planned issue a discussion paper on technology for delivering broadband over powerlines (BPL) in April.

However, an ACA spokesman said that the regulator wouldn't be able to put a firm time-line on the release of the final regulations until the discussion paper was released.

"The challenge for the ACA is to set regulatory arrangements that do not unnecessarily inhibit the adoption of BPL but at the same time protect radio communications from harmful interference," ACA acting chairman Bob Horton said.

The establishment of BPL standard could provide a cheap, alternative last-mile infrastructure for delivering broadband to household at speeds up to 20 Mbps. It could also give householder a simple method for interconnecting household devices.

Three electricity companies are conducting trials of the technology in Australia. Energy Australia and Country Energy are currently trialling the technology in Newcastle and Queanbeyan respectively, while Aurora Energy is testing BPL in Tasmania.

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check out <http://canterbury.cyberplace.co.nz/ouruhia/>  
and [www.neilcherry.com](http://www.neilcherry.com)

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A new technological development may delay for many years the need to build new transmission power lines.

3M is supporting the advanced testing of its new Aluminum Conductor Composite Reinforced (ACCR) conductor. The new conductor uses a core of aluminium-matrix-composite wires surrounded by temperature-resistant aluminium-zirconium wires. According to officials at the Department of Energy, the composite core is stronger than steel, but doesn't elongate as do conventional cores.

The new conductor, which has been under development for many years, carries up to 3 times as much current as conventional steel conductors of the same size.

Accordingly, it is likely most of the need for new transmission capacity can be met merely by replacing existing conductors with the ACCR conductor. Therefore, it will no longer be necessary to build new transmission lines, and it should now be possible to remove those existing lines that have undue environmental or human impacts.

Much testing are underway. The National Transmission Technology Research Center in Oak Ridge, TN is testing the new conductor. Separately, the Tennessee Valley Authority has strung a test line near Oak Ridge. Using a \$4 million Congressional appropriation, the Western Area Power Administration has just begun a year-long test of a one mile, medium sized 795 kcmil conductor in a 230-kv installation near Fargo, N.D., under some of the most challenging weather conditions in the U.S.

Pictures of this new wire and links to additional information can be found at <http://www.powerlinefacts.com/EMF.htm#accr>. A search on "Aluminum Conductor Composite Reinforced" using Google or other search engines will similarly provide much additional information.

Environmental Protection for Children Trust  
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Our submission is that a “Power Corridor” be placed beneath the high voltage transmission lines to exclude buildings to the point that 0.002 microwatts per square centimetre and below are reached. Buildings meaning houses, shops, malls factories and other places of work or residence. Therefore zoned accordingly.

#### Power Corridor

Power Corridors are used in many countries throughout the world to protect people from the harmful effects on health from the exposure to electromagnetic radiation.

Internationally the term “Power Corridor” means where high voltage power lines are placed and people and animals are excluded from working or residing for long periods of time (more than 1-2 hours, etc) in these areas.

In New Zealand the term “Power Corridor” seems to mean where high voltage transmission lines are placed, without referring to the exclusion of people and animals from these areas.

The provision should also be made for the upgrade/expansion/increase in the high voltage transmission lines, therefore the Power Corridor exclusion zone may need to be wider.

#### 0.002 microwatts per square centimetre

0.002 microwatts per square centimetre is a point at which researchers have never had papers peer reviewed and published on effects from electromagnetic radiation.

The reason for the provision is to protect people, especially those that never have a say in where they live like children, from the harmful effects of manmade electromagnetic radiation.

In view of recent reports from California, USA and Japan showing increased incidence of cancers like Leukemia that are linked to exposure of electromagnetic radiation from the high voltage transmission lines, we believe it is irresponsible to allow people to reside or work beneath these high voltage transmission lines. And given the current climate that ACC is only covering accidents, therefore any illnesses that may in the future be proved to have been caused by exposure to the electromagnetic radiation from the high voltage transmission lines, may be litigated against those that allowed houses and workplaces to be placed beneath the high voltage transmission lines, that caused the health problems. Look at AHI with asbestos and what the chemical company that produced dioxin are facing.

We would like the following information to be taken into consideration and thoroughly investigated, when making the decision.

a. The report was prepared by the California Department of Health Services under contract to the California Public Utilities Commission. The report was 9 years in preparation and cost over \$7 million. Based upon an extensive review of the literature plus considerable original research. It is particularly significant because it incorporates the dramatic change of the epidemiology of power frequency magnetic fields that began with the British Journal of Cancer study in October 2000. That study and subsequent research showed that the previous research that failed to detect a link between power

frequency magnetic fields and serious disease had used incorrect methodologies, and that the application of the correct methodologies to this older research did demonstrate the existence of such a link.

In its Executive Summary, the three researchers who conducted the study conclude:

"To one degree or another, all three of the DHS scientists are inclined to believe that EMFs can cause some degree of increased risk of childhood leukemia, adult brain cancer, Lou Gehrig's Disease, and miscarriage."

"All three scientists had judgments that were "close to the dividing line between believing and not believing" that EMFs cause some degree of increased risk of suicide, or For adult leukemia, two of the scientists are "close to the dividing line between believing or not believing" and one was "prone to believe" that EMFs cause some degree of increased risk."

#### b. ELECTROMAGNETIC FIELDS AND HEALTH

BY: Richard W. Woodley - Bridlewood Residents Hydro Line Committee

Ionizing and non-ionizing radiation are separated on the electromagnetic spectrum by visible light - a frequency of roughly 500 trillion cycles a second. Above that frequency is ionizing radiation which contains enough energy to physically alter the atoms it strikes, changing them into charged particles called ions. Below visible light the low frequency waves are non-ionizing - they do not possess enough energy to charge atoms. Ionizing radiation, such as nuclear radiation and X-rays, have long been known to be harmful. However, the question of the health effects of electromagnetic radiation, which is non-ionizing is a controversial one.

Some of the first warnings came in 1972 when scientists in the Soviet Union reported strange health effects in switchyard workers who were routinely exposed to high levels of electromagnetic fields. The workers experienced increased heart disease, nervous disorders, blood pressure changes, recurring headaches, fatigue, stress and chronic depression.

Although concerns had been raised earlier, one of the first epidemiological studies to indicate a health risk was a 1979 University of Colorado study by Dr. Nancy Wertheimer and Ed Leeper which reported a two to three fold increase in cancer deaths among children living near high current power lines in Denver, Colorado.

In November 1986 Dr. David Savitz, of the University of North Carolina, reported the results of a study done as part of the New York Power Lines Project which confirmed Wertheimer and Leeper's findings. The study found increased incidences of childhood cancer and leukemia associated with EMF exposures above 2.5 mG. Dr. Savitz's final report to the New York State Health Department stated: "The degree of confidence placed in these findings is open to varying interpretation, but the tentative conclusion that the study is supportive of an association of electromagnetic fields (EMFs) and cancer risk is warranted."

Dr. David Carpenter, the Executive Secretary of the New York Power Lines Project, in response to statements that the Project "revealed no evidence that magnetic fields pose a health hazard" stated: "Any logical person cannot conclude that there are no effects." He said "It's just wrong to imply that there are no hazards." A second New York Power Lines Project was soon planned.

The findings of the Wertheimer and Leeper and Savitz studies were confirmed by a 1991 study by S.J. London et al., published in the American Journal of Epidemiology.

A University of Southern California study undertaken by John Peters and colleagues and published in the American Journal of Epidemiology in November 1991 also confirmed these findings. Public Power Weekly reported on January 28 1992 that: "The most comprehensive study to date of childhood leukemia and exposure to electromagnetic fields offers additional evidence that proximity to power lines may increase leukemia risk."

When wire codes were used to measure exposure, the risk of leukemia among children with the highest exposure to magnetic fields was about two times greater than the risk of leukemia among children with the least risk.

There was no clear association shown when direct measurements of magnetic fields in the children's residences were used as an indication of exposure. However the discrepancy between results based on measurements and those using wire codes may mean that wire codes are a more accurate predictor of magnetic fields, according to the researchers. They stated: "Although magnetic fields are imperfectly approximated by wiring configuration, the wiring configuration is determined with little error, is unlikely to change over time within a residence, and therefore, may actually be a superior indication of long-time field exposure than the measurements taken." "Even though our 24-hour measurements were longer than measurements made in previous studies, they're still just snapshots", said Peters. "The estimates based on wiring configuration may better reflect the long-term exposure."

These findings were further confirmed by a 1992 Swedish study by Maria Feychting and Anders Ahlbom which reported a higher relative risk of 2.7 times for childhood leukemia and 1.7 times for leukemia in adults for subjects exposed to higher magnetic field levels compared with the control group in the study.

Christine Gorman in the October 26, 1992 issue of Time, stated: "One of the most telling results was that the cancer risk grew in proportion to the strength of the electromagnetic field." She reported that children with constant exposures to the weakest fields (less than 1 mG) had the lowest incidence of cancer. Those exposed to 2 mG had a threefold increase in risk and those exposed to 3 mG had a fourfold increase in the risk of leukemia. As Gorman stated: "Such a clear progression makes it difficult to argue that factors other than exposure to the electromagnetic field were responsible for the extra cases of leukemia."

As well a 1992 Danish study conducted by Dr. Jorgen H. Olsen found a five-fold increase in the risk of childhood leukemia, lymphomas and brain tumours where children living near power lines were exposed to 4 mG.

Children are not the only ones at risk. Microwave News reported in March/April 1990 that "there are now at least 12 studies pointing to an EMF-brain tumour risk". Researcher Dr. Samuel Milham Jr. stated: "There are far too many positive studies to dismiss an EMF-brain tumour connection".

As well, Microwave News reported in July/August 1990 that epidemiologists at the Fred Hutchinson Cancer Research Center in Seattle, WA, had uncovered new evidence for an association between occupational exposures to electromagnetic fields (EMFs) and the development of male breast cancer.

The study supports the preliminary findings of a Johns Hopkins University (JHU) study, reported last year, showing an increased risk of male breast cancer among young New York telephone workers.

Paul Demers, working with Dr. David Thomas's research group at the Hutchinson center, has found that telephone linemen, electricians and electric power workers have six times the expected rate of male breast cancer - a statistically significant increase. For radio and communications workers, the risk was almost tripled. Overall there was a doubling of the cancer risk for all EMF-exposed workers.

A further Norwegian study found twice the expected rate of breast cancer in men in occupations which involved exposure to electro- magnetic fields.

As well, a study by University of North Carolina researcher Dana Loomis published in the June 15, 1994 issue of the Journal of the National Cancer Institute, found that women in electrical occupations are 38% more likely to die of breast cancer than other working women. The study found the breast cancer death rate was more than twice as high among female telephone installers, repairers and line workers, compared with women in non-electrical occupations. The results support four previous studies that found elevated breast cancer rates among male electrical workers.

Another study, conducted by Dr. Tora Tynes of the Cancer Registry of Norway, found that in a sampling of over 2,000 female licensed ship radio operators born between 1934 and 1969, the risk of developing breast cancer was almost twice that of other Norwegian women.

Another occupational study, funded by Hydro-Quebec, Ontario Hydro and Electricite de France, was released at the end of March 1994. It found a link between the magnetic fields generated by electrical currents and an increased incidence of leukemia among utility workers. These findings confirm the results of a 1991 study by Genevieve Matanoski that found telephone workers employed by AT&T with higher EMF exposures had 2.5 times the rate of leukemia as employees with lower exposures.

"We believe our results speak for an association between occupational exposure to magnetic fields and at least one type of leukemia" conclude the authors, led by Dr. Gilles Theriault of Montreal's McGill University.

They found that workers with above-average exposure to magnetic fields were three times more likely to develop acute myeloid leukemia than less-exposed workers. Acute myeloid leukemia is one of the most common types of leukemia among adults.

A University of North Carolina School of Public Health study conducted by Dr. David Savitz and Dr. Dana P. Loomis published in January 1995 in the American Journal of Epidemiology found that utility workers have a greater chance of dying of brain cancer. The results demonstrated that workers with the highest EMF exposures had more than a two-and-a-half times greater chance of dying of brain cancer than the least exposed workers. The researchers also observed a strong exposure-response relationship for brain tumours.

Over 40 occupational studies have shown that adults who were routinely exposed to high EMFs in their work environment had a significantly increased chance of dying of cancer when compared to other workers.

In *The Great Power-Line Cover-Up*, published in 1993, Paul Brodeur cites a review of 51 epidemiological studies of electromagnetic field exposure and cancer risk published in a California Department of Health Services handbook. It found that 28 studies (55%) reported a statistically significant risk, 15 studies (29%) reported elevated but nonstatistically significant risk, and 8 studies (16%) reported no association.

In the same book Brodeur also refers to remarks made by Dr. David Carpenter, the Executive Secretary of the New York Power Lines Project, in the keynote speech at a conference on electromagnetic fields in Meriden, Connecticut on July 28, 1992. Dr. Carpenter, was responding to a June 1992 report of the Connecticut Academy of Science and Engineering which stated that there was not enough evidence to support a conclusion that electromagnetic fields could cause cancer. Brodeur states:

"Pointing to the consistency of results between several childhood cancer studies and more than two dozen occupational studies, he declared that the weight of the evidence clearly showed that people exposed to power-line frequency fields at home and at work were experiencing an increased risk of developing leukemia and brain cancer. He said that recent studies showing increased breast cancer in men who were occupationally exposed to power-frequency fields were particularly worrisome, and he warned that if breast cancer and other reproductive cancers in women were also found to be associated with magnetic-field exposure, the nation would be facing a major public health hazard.... He added that to do nothing about the problem was unacceptable because 'we are where we were with cigarette smoking twenty five years ago'".

In 1994 three new epidemiological reports were released. One indicated a tie between occupational exposure to EMFs and Alzheimer's disease, another indicated a link with Sudden Infant Death Syndrome (SIDS), and another indicated a tie with Amyotrophic lateral sclerosis.

In a case-control study of 387 Alzheimer's patients and 475 controls, Dr. Eugene Sobel of the University of Southern California School of Medicine and colleagues found an association between occupational exposure to electromagnetic fields (EMFs) and Alzheimer's disease. The study was made up of two Finnish groups and one American group of subjects. Researchers found that the overall odds ratio of subjects occupationally exposed to "high" and "medium" levels of EMFs developing Alzheimer's was 3.0 ( $p < 0.0003$ ) compared to subjects exposed to "low" levels of EMFs.

A researcher at Coghill Research Labs in England recently reported the results of a study on the relationship between Sudden Infant Death Syndrome (SIDS) and EMFs. This study examined the location of all SIDS cases in Inner North London between January 1986 and July 1988 in relation to obvious sources of EMFs. The researcher found that not only were SIDS infants living significantly nearer to EMF sources than controls, but the nearer the EMF sources, the younger in age did the infants die. The author concluded that there is a correlation between chronic EM field exposure and SIDS.

Laboratory studies have also shown health effects from electromagnetic radiation. Cass Peterson, writing in *The Washington Post*, states: "Similarly, numerous animal studies have demonstrated neurological or reproductive effects from low frequency electro-magnetic fields. Chick embryos show a higher rate of abnormalities when exposed to low-frequency fields, mice suffer a higher rate of abortion and abnormal fetuses when exposed to slightly higher frequencies, approximating those emitted by video display terminals." Peterson further stated: "In separate experiments, scientists at the Cancer Therapy and Research Centre in San Antonio discovered human cancer cells exposed to 60 Hz fields (the frequency of a high-voltage line) grew as much as 24 times as fast as unexposed cells and showed 'greatly increased resistance to destruction by the cells of the body's defense system.'"

While doing research for the New York State Power Lines Project Dr. Jerry Phillips and Dr. Wendell Winters discovered that human cancer cells proliferated like crazy when exposed to magnetic fields. As well, the exposed cells became increasingly resistant to the body's immune system.

Drs. Phillips and Winters stated that their observations led them to believe that it was possible that magnetic fields stimulate the rate of cancer cell growth, or act as a cancer promoter.

Research into how magnetic fields are linked to cancer is also being undertaken. For example, Dr. Russell Reiter believes that a variety of different cancers may be promoted by magnetic fields. In a paper presented in November 1993 at a United States Department of Energy meeting, he explained that "the suppression of melatonin by magnetic fields could result in a higher incidence of cancer in any tissue," This effect could clear up "one of the mysteries of the magnetic field/cancer issue," that is, "the large number of different types that have reportedly increased," he suggested. A leaked United States National Council on Radiation Protection report (discussed later in this article) supports this theory.

A British study conducted by Denis Henshaw and colleagues at the University of Bristol, published in the International Journal of Radiation Biology on February 14, 1996, found that power lines attract particles from radon gas, a known carcinogen. They have found evidence that the harmful concentrations of radon products may be present around overhead power lines. The electromagnetic fields associated with the lines can therefore concentrate a cocktail of potential carcinogens.

We only have room here to cite a sampling of the hundreds of laboratory studies that have shown a link between EMFs and health effects.

The utility industry's latest strategy is to argue that we cannot prove that there is a health risk from electromagnetic fields until we know exactly how magnetic fields cause cancer, leukemia or other diseases. This is a false argument as Paul Brodeur clearly points out in his 1993 book *The Great Power-Line Cover-Up*. He states:

"What industry spokespeople conveniently overlooked, of course, was that thirty years after definitive epidemiology had been conducted to show that asbestos was a potent cancer-producing agent, scientists still do not know the mechanism by which an inhaled asbestos fibre reacts in lung tissue to cause cancer. Nor do they understand the mechanism by which cigarette smoke reacts in lung tissue to cause cancer. Or how the chemical pesticide DDT operates in breast tissue to cause breast cancer. Suffice it to say, if public health authorities had been required to wait for the cancer-producing mechanisms of these agents to be fully understood, regulations governing asbestos exposure would not have been implemented; warnings on cigarette smoking would not have been issued; and the twenty-year old ban on DDT would not have been imposed."

In the United States several courts have ruled on the health risk issue.

In late 1985, after parents brought suit, a Texas court ruled that Houston Lighting & Power had shown "callous disregard" of their children's health by siting a 345 kV line within 200 feet of a school and playground. The court ordered the utility to relocate the line.

In June 1989 a Florida judge ruled that children may not play in a Boca Raton school yard which borders on high voltage power lines. The suit was brought by three local parents who sought to close the Sandpiper Shores school because of potential electromagnetic field health hazards.

The judge noted that children have "no choice" about going to school and therefore EMF exposure at school is an involuntary risk: He stated that "a 1% chance that there is substantial danger is unacceptable".

Official recognition of the health hazards of electromagnetic radiation is slowly coming. In a report issued June 19, 1989 the United States Congressional Office of Technology Assessment stated: "Electric and magnetic fields produced by electric power systems may pose public health hazards." The report states that a growing amount of evidence now indicates that, under certain circumstances, even relatively weak extremely low frequency (ELF) fields can cause biological changes and that, although the implications are still unclear, "there are legitimate reasons for concern".

Among the report's proposals is a strategy of "prudent avoidance": attempting to route new transmission lines so that they avoid people; widening transmission line rights-of-way; developing designs for distribution systems - including new grounding procedures - which would reduce the associated fields; and redesigning appliances to minimize or eliminate fields.

Further official recognition comes from a United States Environmental Protection Agency draft report which, according to The New York Times (May 23, 1990), says that there is a possible link between cancer and the electromagnetic fields generated by power lines. In particular, the agency's survey of existing human health studies found that children exposed to such radiation seemed to face a higher than normal risk of developing leukemia.

The findings on the possible health effects of exposure to radiation from electromagnetic fields generally agree with those in the report issued previously by Congress's Office of Technology Assessment.

Of the EPA report, Time magazine reported, on July 30, 1990, that Louis Slesin of Microwave News, has printed what may be his greatest scoop: the key paragraph of a two-year Environmental Protection Agency study recommending that so-called extremely low-frequency fields be classified as "probable human carcinogens" alongside such notorious chemical toxins as PCBs, formaldehyde and dioxin. The recommendation, which could have set off a costly chain of regulatory actions, was deleted from the final draft after review by the White House Office of Policy Development. "The EPA thing is a stunner," says Paul Brodeur, a writer for the New Yorker. "It's a clear case of suppression and politicization of a major health issue by the White House."

Paul Brodeur wrote of the EPA report in The New Yorker: "In spite of the deletion, the summary-and-conclusions section of the draft EPA report contained a persuasive indictment of power-line magnetic fields as a cancer-producing agent. Its authors stated that five of the six case-control studies published in the peer-reviewed medical literature showed that children who lived near power lines giving off strong magnetic fields were developing cancer more readily than children who did not live near power lines."

Further official recognition came on June 29, 1994 when Washington State's Department of Labor and Industries ruled that a former smelter employee of Kaiser Aluminum and Chemical corporation in Tacoma was entitled to worker's compensation for cancer he claims was caused by exposure to electromagnetic fields (EMFs) on the job. This is the first ruling by a U.S. government body acknowledging a link between EMF exposure and cancer. The complaint filed by James Brewer pointed out that eight Kaiser employees out of the 90 who worked with him in the smelter's "pot room" had developed lymphoma or leukemia and died. Aluminum smelting requires unusually high levels of

electrical power and consequently workers are exposed to high magnetic field levels during the manufacturing process. In the pot room Brewer was also frequently exposed to intense heat and noxious chemicals including benzene and polycyclic aromatic hydrocarbons.

Mr. Brewer's physician, Dr. Samuel Milham, has asserted a link between EMF and cancer in aluminum smelters in his research. Dr. Milham studied Kaiser's aluminum plant during the 1980s and found "way too many cases" of leukemia and non-Hodgkin's lymphoma among workers there. The high incidence of cancer in the Kaiser workers coincides with similar findings in other aluminum plants.

The latest official recognition of the health risk comes in a leaked United States National Council on Radiation Protection report funded by the Environmental Protection Agency and written by eleven leading American experts in EMFs. Bob Edwards, in the October 7, 1995 issue of *New Scientist*, writes that the report recommends an EMF safety limit of 2 mG (0.2 microteslas). He writes:

"EPA officials say the report is the most comprehensive study ever on the health effects of low-frequency EMFs. Its findings represent a fundamental challenge to the electricity industry. The authors say that their recommendations, if accepted, could force 'complex and costly' changes in society's use of electricity.

"The committee's chairman, Ross Adey, a neurologist from the Veterans Affairs Medical Centre in Loma Linda, California, says there is now a 'powerful body of impressive evidence' to suggest that very low exposure to EMFs has subtle, long-term effects on human health. 'The sensitivity of the brain and its mechanisms to these fields is the key to understanding this issue,' he told *New Scientist*.

"The report recommends that future developments adopt a safety limit of 0.2 microteslas. This is a very weak magnetic field, and stronger fields are common around electricity pylons and close to electrical appliances. New nurseries, schools and houses should not be built where EMF exposures breach that guideline, says the report, and power lines should be kept away from residential areas. Offices should be designed to keep workers' exposure from computers, photocopiers and printers below 0.2 microteslas."

The final report is expected to be released to the public in late 1996 or 1997.

Public health officials are now beginning to take a position on the EMF issue.

Patti Miller, who is in charge of the Washington State Department of Health EMF Task Force, is quoted by Ellen Sugarman in *Warning: The Electricity Around You May Be Hazardous to Your Health* as stating: "In the Department of Health, we've been answering questions about the dangers by telling people to avoid fields at the level of 3 mG. The utilities recently complained to the governor's office about it and the governor has tried to make us stop saying this when people call. But we feel strongly that we can't just pass the buck the way they do. After all, we're responsible for the public health."

Dr. David Carpenter, former Executive Secretary of the New York Power Lines Project and now Dean of the State of New York School of Public Health, is quoted by Ellen Sugarman as stating:

"I am now convinced that EMFs pose a health hazard. There is a statistical association between magnetic fields and cancer that goes beyond the shadow of reasonable doubt. I think there is clear evidence that exposure to EMFs increases the risk for cancer. This is most clear with leukemia and brain tumours, but in the residential studies, statistical significance increased for all kinds of cancer.

And we're just beginning to have a whole body of evidence that reproductive cancers are increased by exposure."

The World Health Organization has, in early 1996, initiated a 5 year \$3.33 million project to assess the health and environmental effects of exposure to electric and magnetic fields. An International Advisory Committee will oversee the project.

Perhaps the most significant new factor concerning the EMF health factor is the increasing public awareness. The January 1-3, 1993 issue of USA Weekend, a Sunday supplement magazine with a readership of thirty-three and a half million, contained a poll that asked readers to select what they considered to be the United States number one environmental health priority. The results were announced in the February 19-21, 1993 issue of the magazine. Electromagnetic fields were selected as the number one priority by 35% of the readers; 17% chose chemicals in food; 12% chose indoor air quality, and 36% listed other environmental concerns.

c. Association Of Health Problems With 50 -Hz Magnetic Fields In Human Adults Living Near Power Transmission Lines.

Ivan I. Beale, PhD, Neil E. Pearce, PhD, Roger J. Booth, PhD, Sandra A. Heriot, PhD. Journal of the Australasian College of Nutritional & Environmental Medicine, Vol. 20 No.2 (August 2001) pp. 9-12, 15, 30.

d. "Evidence that Electromagnetic fields from high voltage powerlines and in buildings, are hazardous to human health, especially to young children" By Dr Neil Cherry,

Although numerous studies of animals and cell cultures indicate effects of power-frequency magnetic fields on immune-system function, few studies have looked for evidence of an association between environmental power-frequency magnetic field exposure and immune-related illnesses in humans. This study used a cross-sectional design to examine the dose-response relationship between magnetic-field exposure of adults in their homes and prevalence of immune-related and other chronic illnesses. Five-hundred-and-sixty adults living near extra-high-voltage transmission lines completed questionnaires about their health and demographic characteristics. Derived health variables were related to individual estimates of time-integrated magnetic field exposure. Five of the eight health variables showed a linear dose-response relationship with exposure. After adjustment for possible confounding, significantly elevated odds ratios were obtained at higher exposure levels both for asthma and for combined chronic illnesses. The results are consistent with a possible adverse effect of environmental magnetic field exposure on immune-related and other illnesses.

e. Japan Study-Danger Within 100 Meters of HVTL, Electromagnetic waves linked to children's brain tumor

Exposure to electromagnetic waves from high-voltage power lines and some electronic appliances could increase the risk of brain tumor among children who live close to the source of emission, according to a three-year government-sponsored study.

Ultralow frequency electromagnetic waves are produced primarily by high-voltage power grids, whose effects on human bodies have been studied by overseas researchers. The same type of electromagnetic waves is also released in tiny amounts from computers and other home appliances.

While the study in Japan -- initiated three years ago by the former Science and Technology Agency, now part of the education ministry -- has shown a link between brain tumor and exposure to electromagnetic waves, authors of the report caution that the finding is not conclusive due to a limited size of the samples available for the project.

The study, undertaken by the National Institute for Environmental Studies, Tokyo Women's Medical University and others, compared the level of electromagnetic waves in the bedrooms of 100 healthy children and 60 children suffering from brain tumor below age 15, examining each case over a one-week period.

The researchers then tabulated the data after adding factors such as the average level of electromagnetic waves in the entire house, the extent of use of electric appliances and the distance between a child's room and a high-voltage power line.

The results, posted on the education ministry Web site on Friday, show that children exposed to more than 0.3 microtesla of extralow frequency electromagnetic waves, or three times the normal level, are 10 times more likely to develop brain tumor.

The researchers found that the level of electromagnetic waves actually topped 0.3 microtesla in the rooms of five children with brain tumor and one healthy child, and the rooms of three of the children with brain tumor were located within 100 meters of a high-voltage power transmission line.

The researchers have also found that exposure to electromagnetic waves above 0.4 microtesla would double the risk of childhood leukemia. The final report released Friday says the risk of developing acute lymphoblastic leukemia is comparatively higher than the risk of acute myelogenous and other types of leukemia. 06/06/03

#### f. Taiwan Study Links Childhood Leukemia, Transmission Lines

Microwave News March/April 1998

An elevated risk of leukemia has been found among children living near high-voltage transmission lines in metropolitan Taipei, Taiwan. The study drew on data from Taiwan's National Cancer Registry for the years from 1987 to 1992.

Children living in areas within 100 meters of a transmission line had a leukemia rate 2.7 times higher than did children in the nation as a whole, a significant increase. Their cancer risk was 2.4 times higher than that of other children in the same neighborhoods, a finding just short of statistical significance.

Dr. Chung-Yi Li of the College of Medicine at Fu-Jen Catholic University, Taipei, and Drs. Wei-Chin Lee and Ruey Shiung Lin of National Taiwan University, Taipei, report these results in the February Journal of Occupational and Environmental Medicine (40, pp.144-147, 1998). Formerly with the Maryland Department of Health, Lin was the first epidemiologist to link brain cancer to occupational EMF exposure (see Microwave News, O84 and J/A85).

"I tend to think that EMFs are responsible for what we observed in the study," Li told Microwave News. But he added that epidemiological methods could not do much more to clarify the EMF-cancer link. Li believes that epidemiologists should now turn their attention away from power lines and try to discover if there are any as-yet-unknown risk factors for leukemia. If a new one is found, researchers could then examine whether it is associated with power lines. "After all," he commented, "there must

be something responsible for the association." If no other factors can be identified, it would strengthen the argument that EMFs are to blame.

The Taiwan team did not measure the distance of each house from the line. Instead, they based the study on areas where most of the land lies within 100 meters of a high-voltage transmission line. While acknowledging that this is a "crude" measure, they argue that any exposure misclassification would likely underestimate the risk.

A measurement study in the same part of Taiwan by Li, Lin and Dr. Gilles Thériault of McGill University in Montreal, Canada, found that high-voltage transmission lines produced fields of about 2 mG inside houses 100 meters away, with higher fields in houses that were closer. The same group also found a link between adult leukemia and calculated historical EMF levels in the home (see Microwave News, M/J97)

g. New Scientific Evidence Reawakens Concerns About Electromagnetic Fields Generated by Power Lines, Household Electrical Wiring and Appliance Usage

ST. PAUL, Minn., Feb. 10, 1998 /PRNewswire/ -- Two new studies reawaken concerns about the risks of exposure to electromagnetic fields (EMF). This research, which was conducted by collaborating scientists from Hughes Institute, St. Paul, Minn.; University of Minnesota, Minneapolis, Minn.; University of California, Riverside, Calif.; Yale University, New Haven, Conn.; and Kansai Medical University, Moriguchi, Japan, will be published in the Journal of Biological Chemistry, official journal of the American Society for Biochemistry and Molecular Biology. The first report will appear in the February 13, 1998 issue and the second in April, 1998.

Conducted under the aegis of a research grant award from the National Institutes of Environmental Health Sciences (grant number R01-ES-07175), the studies provide conclusive evidence that inside cells electromagnetic fields can activate certain signaling pathways that have been associated with cancer. Specifically, it was discovered that the products of cancer promoting genes known as Src tyrosine kinases are rapidly activated by EMF exposure. The functions of other key cellular elements facilitating the cancer-promoting function of these tyrosine kinases also seem to be amplified five- to ten- fold. In addition, the results of these studies demonstrate that EMF may alter biochemical events inside the elements of the immune system that determine our susceptibility to infections.

These studies are the first to shed light on the possible mechanism for the long-suspected albeit controversial links between EMF exposure and cancer risk. A number of epidemiologic studies suggested the possibility that EMF radiation from power lines, household electrical wiring and appliance usage may contribute to the risk of childhood leukemia. Recent reports showed that living in homes characterized by high measured time-weighted average magnetic field levels or by the highest wire-code category does not increase the risk of leukemia in children. However, concerns regarding other forms of EMF exposure remain. It is thought that EMF may participate in the production of leukemia by influencing the proliferation, survival, and/or differentiation programs of leukemia cells.

The results of these studies reawaken concerns and urge more research, awareness and public discussion about the potential risks of electromagnetic field exposure. For technical information, contact the corresponding senior author, Dr. Fatih Uckun, Hughes Chair in Oncology, Hughes Institute, by paging him at 800-670-0268.

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Dibirdik I, Kristupaitis D, Kurosaki T, Tuel-Ahlgren L, Chu A, Pond D, Tuong D, Luben R, Uckun FM. Stimulation of Src family protein tyrosine kinases as a proximal and mandatory step for SYK kinase-dependent phospholipase C Gamma 2 activation in lymphoma B-cells exposed to low energy electromagnetic fields. *Journal of Biological Chemistry*. 273:4035-4039, 1998

Kristupaitis D, Dibirdik I, Vassilev A, Mahajam S, Kurosaki T, Chu A, Tuel- Ahlgren L, Tuong D, Pond D, Luben R, Uckun FM. Electromagnetic field-induced stimulation of bruton's tyrosine kinase (BTK). *Journal of Biological Chemistry*. in press, 1998.

h. In a recent Oxford study, scientists checked the records of 35,000 children diagnosed with cancer and studied how close they lived to a cable.

The research shows there is a 100m danger zone around high voltage lines and that children under 15 had double the normal risk of leukaemia.

It is estimated that powerlines might account for 20-30 of the 500 cases of childhood leukaemia in Britain each year. They are also suspected of causing other forms of cancer and miscarriages.

Draper G, Vincent T, Kroll M & Swanson J - Childhood cancer and electromagnetic field exposures from powerlines – Department of Health funded 1997-2001, RRX 46

Reports to follow.

Environmental Protection for Children Trust  
240 Prestons Rd  
Marshland  
Christchurch

**We seek the following decision from the Environment court that**

1. a Power Corridor be placed beneath the high voltage transmission lines which excludes people from spending any length of time being exposed to electromagnetic radiation from these transmission lines at levels above 0.002microwatts per square centimetre.
2. The power corridor is to be wide enough to allow for future increases and upgrades on the high voltage transmission lines.
3. At the boundary of the power corridor the electromagnetic radiation levels shell never exceed 0.002 microwatts per square centimetre.

# Risk of Leukemia in Children Living Near High-Voltage Transmission Lines

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*We conducted a study to examine the risk of leukemia between 1987 and 1992 among children living near high-voltage transmission lines (HVTL) in three urban districts of northern Taiwan. Twenty-eight cases of leukemia among some 120,696 children aged 14 years or less were reported to the national cancer registry between 1987 and 1992. Compared with children living in households more than 100 meters away from HVTL, children living in households less than 100 meters from HVTL experienced an essentially elevated risk of leukemia (7 versus 2.88, standardized incidence ratio [SIR] = 2.43, 95% confidence interval [CI] = 0.98–5.01). The elevated risk stands when compared with all children of Taiwan alternatively (7 versus 2.60, SIR = 2.69, 95% CI = 1.08–5.55). Such elevated risk was particularly noteworthy among children aged 5–9 years. The findings suggest that children living near HVTL tend to experience an elevated risk of leukemia. Further investigations are undoubtedly needed to unveil whether such tendency may have implied the putative association between exposure to elevated magnetic fields and risk of childhood leukemia.*

**W**e previously reported a significantly elevated risk (standardized incidence ratio [SIR] = 1.49, 95% confidence interval [CI] = 1.16–1.91) of childhood leukemia for the period from 1979 to 1988 in the five districts of Taipei Metropolitan Area, where high-voltage transmission lines (HVTL) (69–345 kilovolts [kV]) pass over at least one elementary school campus.<sup>1</sup> Since our previous study considered all children residing in the five districts to have higher-than-background exposures to power frequency magnetic fields, which is essentially not valid, we used a more precise method in the study presented here to determine the children's residential exposures to magnetic fields and to reassess the potential risk of childhood leukemia in relation to ambient magnetic fields in northern Taiwan. Information from one recent study indicated that Shihlin, Tucheng, and Hsichuh were the districts densely scattered with high-power transmission lines in the Taipei metropolitan area of Taiwan.<sup>2</sup> We therefore selected these three districts as the study area in the study presented here in order to identify an exposed cohort large enough for the purpose of gaining adequate statistical power in risk estimation. In addition, taking into account the annual incidence rate of childhood leukemia in Taiwan and the completeness of the National Cancer Registry, we decided to cover the period between 1987–1992 in order to gain sufficient number of cases of childhood leukemia. Dissimilarity in study period coverage between the present study and our 1994 study (1979–1988)

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**TABLE 1**  
Population and Housing Units in the Study Districts

% of Grids in Each "li" <sup>**</sup>	No. of "li"				No. of Houses <sup>†</sup>				No. of Children <sup>‡</sup>			
	Shihlin	Tuchen	Hsichuh	Total	Shihlin	Tuchen	Hsichuh	Total	Shihlin	Tuchen	Hsichuh	Total
91-100	0	0	1	1	0	0	1257	1257	0	0	1210	1210
71-90	0	1	1	2	0	1334	1000	2334	0	1177	315	1492
51-70 <sup>§</sup>	2	5	3	10	1933	7216	3143	12292	730	5490	2880	9100
31-50	2	8	4	14	4693	10916	1800	17409	3815	7408	1888	13111
11-20	5	13	12	30	9939	20254	9886	40079	5350	15643	7938	28931
0-10	41	13	13	67	75463	20922	11485	107870	43024	13857	9971	66852
Total	50	40	34	124	92028	60642	28571	181241	52919	43575	24202	120696

\* Within 100-m buffer.

† Annual average no. of houses between 1987 and 1992.

‡ Annual average child (<15 years of age) population size between 1987 and 1992.

§ The "li" within which 50%-70% of grids intersecting with 100-m buffer was considered to be exposed.

also help to avoid selective reporting. This study aims to further examine the risk of childhood leukemia (children aged <15 years) in relation to residential exposure to magnetic fields characterized by residential proximity to HVTL (69-345 kV) in Taiwan.

## Methods

### Study Populations and Cases of Childhood Leukemia

The three districts (Shihlin, Tuchen, and Hsichuh) in the Taipei Metropolitan area with a heavy presence of HVTL were identified from our previous study<sup>1</sup> and were used as the target study area in this study. A total of 124 "li"s, the smallest administrative region in Taiwan, were encompassed within the boundary of the study area. From 1987 to 1992, the annual average number of 120,696 children aged 14 or less was residing in 181,241 housing units (Table 1). During the same period, a total of 28 pathologically confirmed cases of childhood leukemia from the three districts were newly diagnosed and reported to the National Cancer Registration Center of Taiwan.

### Determination of Residential Proximity to High-Power Transmission Lines

The households in the three districts were categorized using utility

route maps with a scale of 1 in 5300 (ie, 1.89 mm = 10 meters [m]) into two categories: (1) households within and (2) households outside 100 m on each side of HVTL. The residential proximity to HVTL was determined stepwise. The pre-computerized utility route maps of the three districts (or 124 "li"s), showing the distributions of major power lines and the boundary for each "li", were first supplied by the state-run Taiwan Power Cooperation. The region within 100 m of HVTL was then identified and inscribed as the buffer zone within which all the residences were considered to have elevated indoor exposures to magnetic fields. A grid with 2 mm on each side (ie, a grid of 112 m<sup>2</sup> in area) was then created and mapped. The 112-m<sup>2</sup> grids were used to determine the percentage of the area for each "li" intersecting with the 100-m buffer. The households in each "li" with  $\geq 50\%$ -70% of grids intersecting with the buffer were considered to be less than 100 m from HVTL. It was estimated that some 15,883 households were located and 11,802 children were residing within the 100-m buffer zones, representing 8.8% of all households and 9.2% of all children in the study districts between 1987 and 1992 (Table 1). The annual age-specific (0-4, 5-9, and 10-14 years) populations of the above two household categories between 1987 and 1992 were derived

from national census statistics, which provide the annual age-specific population sizes for each "li" of the nation.<sup>3</sup>

## Risk Estimation

Children residing within 100 m of HVTL were considered to be "exposed." The expected number of cases (EXP) of childhood leukemia among exposed children was calculated from the person-year approach, using calendar-age (5-year)-specific incidence rate of childhood leukemia in the reference population multiplied by the corresponding calendar and age childhood population in the exposed households. SIRs were estimated by dividing the observed number of leukemia cases (OBS) by the expected (EXP). Two reference populations were used in the study, ie, children living 100 m outside of HVTL in the study districts, and all children in Taiwan.

## Results

Between 1987 and 1992, there were seven cases of leukemia among children residing within 100 m of HVTL in the study districts, and 21 cases among children living at least 100 m away from HVTL in the same area. Compared with those living outside 100 m of HVTL, children in households within 100 m of HVTL showed a marginally significant elevation of SIR of leukemia (7 versus 2.88, SIR = 2.43, 95% CI = 0.98-

**TABLE 2**  
Standardized Incidence Ratio (SIR) of Childhood Leukemia Among Households Within 100 Meters of High-Voltage Transmission Lines\*

Age (years)	OBS	EXP†	SIR	95% CI
0–4	2	1.57	1.56	0.15–4.60
5–9	4	0.85	4.70	1.28–12.1
10–14	1	0.46	2.17	0.07–12.1
Total	7	2.88	2.43	0.98–5.01

\* OBS, observed number of childhood leukemia cases; EXP, expected number of childhood leukemia cases; CI, confidence interval.

† Calendar-age-specific incidence rate among children residing more than 100 meters away from high-voltage transmission lines in the study area was used to compute EXP.

5.01). The SIR was elevated in all of the three ages, with a particularly notable increase among the 5–9-year-old group (4 versus 0.85, SIR = 4.70, 95% CI = 1.28–12.1) (Table 2).

Compared with all children in Taiwan, the children within 100 m of HVTL in the study districts also showed a significantly elevated SIR (7 versus 2.60, SIR = 2.69, 95% CI = 1.08–5.55). The age-specific SIR once again indicated a noteworthy elevation of risk among children of 5–9 years (4 versus 0.79, SIR = 5.06, 95% CI = 1.38–13.0). The children in households outside 100 m of HVTL, on the other hand, do not show any significantly elevated risk of childhood leukemia, as compared with all children in Taiwan (SIR = 1.05, 95% CI = 0.64–1.58) (Table 3).

## Discussion

In our earlier publication, we reported an association between the surrogate for residential exposure to power frequency magnetic fields and the risk of childhood leukemia (age <15 years). The surrogate for residential magnetic fields exposure in that particular study was loosely defined, ie, housing units in districts with at least one elementary school

**TABLE 3**  
Standardized Incidence Ratio (SIR) of Childhood Leukemia Among Households in the Study Area by Distance From High-Voltage Transmission Lines (Cutoff Point = 100 m)

Age (years)	Distance From High-Voltage Transmission Lines			
	<100 m		≥100 m	
	OBS/EXP*	SIR (95% CI)	OBS/EXP*	SIR (95% CI)
0–4	2/1.21	2.48 (0.20–5.97)	10/8.47	1.18 (0.57–2.17)
5–9	4/0.79	5.06 (1.38–13.0)	7/6.40	1.09 (0.44–2.30)
10–14	1/0.60	1.67 (0.05–9.28)	4/5.15	0.78 (0.21–1.99)
Total	7/2.60	2.69 (1.08–5.55)	21/20.0	1.05 (0.64–1.58)

\* National calendar-age-specific incidence rate of Taiwan area was used for calculation of the expected number of childhood leukemia incidences.

campus passed over by HVTL (69–345 kV) were all considered having elevated exposures.<sup>1</sup> We attempted in this study to improve the validity of the surrogate for exposures in which all of the housing units in the study districts were determined with respect to their distance to HVTL, and the exposure levels of children in households were assigned accordingly. With such improvement in exposure assessment, it is believed that the results from the study would be less biased than our previous findings.

Similar to our previous findings, we again noticed an increase in risk of childhood leukemia in relation residential proximity to HVTL. Residential proximity to HVTL has been frequently used as an exposure metric in assessment of the association between exposure to power frequency magnetic fields at home and risk of childhood leukemia<sup>4–6</sup> and has been considered as the most nascent state of assessment of residential magnetic fields, not only because it better captures long-term exposure to electrical utility equipment near residences but also because any biologically important characteristic related to magnetic fields is more likely to be found proximally than distally.<sup>7</sup> Of the three studies of children using proximity to power lines as an exposure metric,<sup>4–6</sup> only Feychting and Ahlbom<sup>5</sup> observed a significantly elevated incidence of leukemia among children residing ≤50 m of major power lines (odds ratio

[OR] = 2.9, 95% CI = 1.0–7.3). The other two studies did not reveal any positive result to support the hypothesis that magnetic fields may cause childhood leukemia.<sup>4,6</sup>

Many previous studies of risk of childhood leukemia in relation to magnetic fields exposure suffered from inadequate statistical power to detect the true association.<sup>8,9</sup> In the study presented here, there were only seven exposed children who developed leukemia during the study period, also causing an imprecise risk estimation. What needs to be addressed herein is that the way we used to identify a cohort with potentially elevated exposures is different from those used in previous cohort or nested case-control studies. Although the proportion of the general population living near HVTL is usually small, given the widespread distribution of electrical distribution systems, there must be a substantial number of people with exposures markedly higher than the background exposure in certain regions with a dense population like Taipei. With computerized utility route maps and large-scale residential maps, it is possible that a sufficient size of individuals from large regions can be easily and rapidly identified to meet the need of epidemiological studies.

In this study, we surveyed households located within 100 m of HVTL (presumably with higher-than-background magnetic fields). The selection of a buffer width of 100 m was

based on the magnetic fields strength at the edge of the right-of-way. In a study measuring magnetic fields of 407 households in northern Taiwan, it was suggested that the indoor ambient magnetic fields attributable to HVTL were some 2 milli Gauss (mG) for households with a distance of 100 m from HVTL, and a higher exposure can be found in households less than 100 m from HVTL.<sup>10</sup> A magnetic fields strength of 2 mG was considered to be above the background exposure in most of the previous studies.<sup>7-9</sup> Since the exposure assessment of the study was based on the distance of each administrative region, rather than the individual housing unit, to the HVTL, the exposure assessment used in the study may have entailed certain degrees of exposure misclassification, which is believed to alter the risk estimates of the study toward the unity for some extent.

Some studies have reported that children living near certain types of power lines have higher than average rates of leukemia and speculated that power lines might be associated with a cancer risk factor other than magnetic fields.<sup>5,11-13</sup> Several possible confounders have been suggested, including medical history of the family, occupation of parents, traffic density, socioeconomic class, and exposure to chemical substances, but they were ultimately found to produce no confounding at all.<sup>12,13</sup> Thus, in view of the evidence available, results of recent epidemiological studies can hardly be dismissed by arguing a known risk factor for childhood leukemia.<sup>8</sup> However, the possibility of presence of an unknown leukemogen to cause a false-positive association in the studies can not be dismissed. Because of a lack of adjustment of potential confounders in the study presented here, we are unable to draw a conclusion

on the role of magnetic fields in the causation of childhood leukemia.

This study provides additional support for the association between residential proximity to HVTL and risk of childhood leukemia. The use of a distance of less than 100 m as a surrogate for magnetic fields is crude in that it also limits the ability of our findings to draw a firm conclusion as to whether the observed association can be attributable to a causal link between magnetic fields exposure at home and the subsequent incidence of leukemia in children. This study also demonstrated one way of identifying a cohort living near HVTL. Although we could not determine the distance of individual housing units to HVTL, we did provide grouped exposure estimates based on reasonable buffer zones. We believe that this method can be useful and efficient in identifying a cohort of sufficient size for further epidemiological studies, at least in regions with dense populations like Taipei. In summary, this study does provide additional support to the association between residential proximity to HVTL and risk of childhood leukemia. We therefore recommend that further studies are warranted in order to uncover what is responsible for such a link. Specifically, the question "If the observed association between residential proximity to HVTL and risk of childhood leukemia is indeed real, then what is to blame?" must be answered by additional scientific research.

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