Commentary

EMF Research: Who's in Charge?

There is one point on which all sides of the EMF debate agree—the need for more research. But even with this unanimity of opinion, there is little hope that a comprehensive research program will begin anytime soon.

The momentum for a National EMF Research Program (NERP) has been building since James Cunningham of the New York Power Authority (NYPA) raised the idea at a congressional hearing in March 1990. All the major industry players—APPA, EEI, EPRI, ESEERCO, LPPC, NEMA, NPPA*—have now endorsed a $20-30 million, three-to-five-year effort to produce "reliable, credible and impartial" results, jointly sponsored by government and industry.

What is missing is government leadership. EPA has just issued a new report with a wish list of 32 high priority EMF projects (see p.9). The DOE has asked for more money for its own research program. And even Dr. Allan Bromley, the President's science advisor—an outspoken skeptic of EMF risks—has conceded that "much remains to be done." Yet none of these government offices has spoken up in favor of the NERP, leaving the states and the utilities to take the lead.

Two key questions remain: Who will run the NERP? And, who will decide who runs it?

Not long ago, it appeared that the Health Effects Institute (HEI) would lead the NERP, but that now seems less likely. HEI has left itself vulnerable to allegations that its asbestos research program (HEI-AR) is tainted by a pro-industry bias. This spring, the National Association of Attorneys General (NAAG) adopted a resolution that expressed "deep concern" that HEI-AR "is incapable of producing an objective, unbiased report...." The NAAG pointed out that HEI has consistently refused to take steps to mitigate these concerns.

Instead of trying to put these charges to rest, HEI President Dr. Andrew Sivak has allowed them to fester. Now, somewhat embarrassed, many NERP backers are distancing themselves from HEI. The NAAG resolution may be what prompted the New York State Department of Public Service to set up a steering committee to establish and oversee the NERP and to reopen the search for an organization to run it (see p.4). In contrast to HEI's desire to restrict attendance at its meetings (see p.5), the steering committee's first action was to open all its deliberations to the public. The committee has already drafted a conflict of interest policy.

Many utilities have endorsed the NERP—some have pledged allegiance directly to HEI. The Los Angeles Department of Water and Power has already given HEI $300,000; Seattle City Light has contributed a lesser amount. (These two utilities, together with the NYPA, were among the original backers of the NERP.) At the same time, others wonder why they should pay for HEI to make up for its lack of EMF experience and why the institute has hired a consulting firm, Gradient Corp., which has other industry EMF clients.

Most utilities will probably follow the NERP steering committee's lead. By federal default, state regulatory officials are calling the shots, and they may deny the power companies the right to charge their rate payers for HEI contributions if it is not designated as the administrator of the NERP.

One persistent refrain heard from all sides is: "Where is EPA?" Not long ago, EPA had the premier EMF research group in the world, but it was disbanded by the Reagan Administration, and now the agency appears utterly incapable of taking on EMFs. A student of bureaucracies would be amazed that an agency would refuse a new multimillion-dollar program. When Congress recently gave EPA $750,000 for EMF research, the agency turned around and gave $525,000 to HEI. The fact that an HEI alumnus, Dr. Ken Sexton, is the director of EPA's Office of Health Research no doubt helps HEI's prospects.

Today, a year after EPA released a draft report linking EMFs to cancer, the agency is still not supporting a single EMF experiment in its own labs—despite its new document calling for a slew of research projects. When the NERP committee invited EPA to explain how it would run the EMF research program, the agency declined to comment.

Much of the responsibility for EPA's paralysis lies with Dr. Erich Bretthauer, the assistant administrator for R&D. A political appointee, Bretthauer is the one who was summoned to the White House when the Bush Administration panicked about the political and economic implications of EPA's cancer report (see *MWN*, N/D90). Clearly, Bretthauer wishes the EMF controversy would go away, but even he realizes that this won't happen. Instead, he wants to hand over the responsibility to HEI—and keep EMFs at arm's length. (When questioned about EPA's commitment to HEI, the official line is that "no decisions have yet been reached.")

Those who look to Congress for a resolution will be disappointed. Rep. Frank Pallone's (D-NJ) funding bill is going nowhere. A number of senior members of the House of Representatives have shown an interest in EMFs, but most are content to hold hearings rather than to press for action. For some unexplained reason, Reps. George Brown (D-CA) and James Scheuer (D-NY) have endorsed the idea of farming out EMF research to an organization outside the government—perhaps HEI.

Everyone's patience is running out: The organizational issues are simple compared to the unresolved scientific questions and the slow start does not bode well for finding any answers soon. Dr. Genevieve Matanoski, the chair of the Science Advisory Board's EMF panel, predicted that the only way to win the public's confidence is to put the research in the hands of the National Institutes of Health. She is clearly on the right track: There will be no real progress until the federal government starts to do its job.

* American Public Power Association (APPA), Edison Electric Institute (EEI), Electric Power Research Institute (EPRI), Empire State Electric Energy Research Corp. (ESEERCO), Large Public Power Council (LPPC), National Electrical Manufacturers Association (NEMA), Northeast Public Power Association (NPPA).

Telephone Linemen Study Now Finds ELF–Leukemia Link

A major epidemiological study from Johns Hopkins University (JHU) in Baltimore, MD, indicates that some telephone linemen exposed to extremely low frequency (ELF) electromagnetic fields (EMFs) had higher death rates from leukemia than other telephone company employees.

Drs. Genevieve Matanoski, Patrick Breysse, Elizabeth Elliott and colleagues at JHU's School of Hygiene and Public Health compared the records of 124 male AT&T workers who had died of acute myelogenous leukemia between 1975 and 1980 with those of 337 matched controls.

Speaking at the *Annual Meeting of the Bioelectromagnetics Society* in Salt Lake City, UT, on June 24, Matanoski reported that, "The risk is greatest for the younger workers," explaining that there is a latency period before the leukemia is observed and that early exposures are important. In a background paper, the Electric Power Research Institute (EPRI), which funded the study, noted that "some relatively high odds ratios" were seen when a 10-15-year latency period was taken into account.

"There is some suggestion of a trend of increased risk with increased exposure," Matanoski said in an interview. Exposure was estimated using a "score" defined as the product of the average daily exposure and the number of years on the job. Those workers with a higher-than-median exposure score had a 2.5 times greater risk of dying of leukemia than those with lower exposure scores.

The association was greater when peak—rather than median—EMFs were used to gauge exposures. Also, when workers were assigned to one of four categories of peak exposures, there was a trend toward higher leukemia risks with increasing exposures. Cable splicers and central office technicians who used older switching equipment had the highest peak EMF exposures.

The results counter the preliminary conclusions of no increased leukemia risk reported by Matanoski in 1988 (see *MWN*, N/D88). "There has been a change," Matanoski told *Microwave News*, explaining that on reviewing the raw data she had found a number of misclassified exposures. When these were corrected, the higher risks were identified. She noted that her data set is still incomplete.

The elevated risk among young workers is supported by a related study on leukemia incidence—in contrast to mortality—by the same JHU researchers. In that effort, first reported in 1989, they observed that young cable splicers had significantly higher rates of leukemia and lymphoma—as well as all types of cancer—than other telephone workers (see *MWN*, N/D89).

Magnetic field measurements taken in 1988-89 among telephone employees showed that average (and peak) exposures were 4.3 (99.2) mG for cable splicers, 2.5 (21) mG for central office technicians, 1.7 (31) mG for installers, 1.6 (26.9) mG for outside plant technicians and 1.5 (29.1) mG for non-linemen.

New National EMF Research Committee Established

A committee of government officials is being assembled to coordinate a $20-30 million National Electromagnetic Field Research Program (NERP). The New York State Department of Public Service (NYDPS) is setting up the committee, with the assistance of the Large Public Power Council (LPPC), to oversee a research effort to be funded jointly with private and public funds.

The NERP is the product of the independent efforts of the NYDPS to follow up on both the New York Power Lines Project (see *MWN*, N/D88) and the LPPC's call in March 1990 for a joint private–public effort (see *MWN*, M/J90).

The steering committee's first task is to select an organization to administer the NERP. The administrative organization will, in turn, select the studies to be funded, operate the project day-to-day and oversee the scientific review of research results. At the moment, the NERP will only investigate extremely low frequency (ELF) electromagnetic field (EMF) effects.

At the NERP committee's first meeting, held June 27-28 in Washington, DC, committee member Susan Tierney stressed that the program must be free of real and perceived conflicts of interest. This is "one of the most important objectives of this panel," she said. Tierney is the Massachusetts secretary of environmental affairs.

John Coughlin, a Public Service commissioner in Wisconsin, is the chairman of the committee. The other members are Charles Imbrecht, chairman of the California Energy Commission, and Michael Wilson, a Public Service commissioner in Florida. (Imbrecht and Wilson could not attend the meeting but sent representatives in their places.) The steering committee expects to add four to six members, including federal officials and, possibly, representatives from citizens' groups, according to Larry DeWitt of the NYDPS.

At the meeting, the committee heard presentations from three of the organizations that the NYDPS had identified as possible administrators of the NERP: the Health Effects Institute (HEI), based in Cambridge, MA; the National Research Council (NRC), an arm of the National Academy of Sciences; and the Institute for Evaluating Health Risks (IEHR)—the latter two are in Washington, DC. Only HEI showed a serious interest in running the program.

Both NRC's John Burris and IEHR's Jack Moore said that their organizations would be interested in helping develop a

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research agenda but that HEI would be better qualified to administer the overall program.

The NYDPS had invited the Environmental Protection Agency (EPA) and the Department of Energy (DOE) to make presentations, but both declined.

The committee members grilled HEI over its controversial asbestos research program (HEI–AR). They were particularly concerned about the National Association of Attorneys General's condemnation of HEI–AR's refusal to answer allegations of conflicts of interest (see p.3). In interviews with *Microwave News*, a number of NYDPS staffers expressed deep concern about HEI's ability to run an open and objective EMF research program. They stressed that HEI might not be selected if the charges cannot be resolved.

At the meeting, DeWitt publicly stated that, "We have to be as concerned with the problem of appearance of a conflict" as with actual conflicts.

New York Power Authority Senior Vice President James Cunningham, who has led the LPPC effort to set up a national research program, urged the committee to act quickly: "I am sure that all utilities, businesses and individuals who have had to deal with this issue...believe it is absolutely essential that this study begin soon." Chairman Coughlin said that the panel will work "as rapidly as possible, but we don't want to get off to a false start."

The steering committee is scheduled to meet again on September 12 in Washington, DC.

HEI Moves Forward in Bid for EMF Research Program

Moving aggressively in its bid to run a national electromagnetic field (EMF) research program, the Health Effects Institute (HEI) convened a group of scientists to evaluate research needs on June 11-12 in Boston, MA. HEI, based in Cambridge, MA, is the leading contender to run a multimillion-dollar, multiyear research effort to be funded by federal and state governments and by the utility industry (see *MWN*, M/A91 and pp.3 and 4).

Dr. Richard Setlow of the Brookhaven National Labs in Upton, NY, the chairman of HEI's 13-member feasibility study committee, said that his panel is seeking to provide the institute with "an informed idea of how an HEI research program would advance our understanding" of EMF health effects. The committee will prepare brief reports identifying key scientific questions and potential research projects. A second, 12-member observers committee will review the documents and provide guidance. (For a list of members of the feasibility committee, see *MWN*, M/J91.)

Once the two EMF committees have made their recommendations, the institute's independent advisory committee will select the projects to be funded, according to HEI President Dr. Andrew Sivak. In an interview with *Microwave News*, Sivak said that he may ask some members of the feasibility and observers groups to serve on the advisory committee to make up for its lack of expertise in physics, engineering and endocrinology.

HEI and the Press

A recurring concern that has dogged HEI is the lack of openness of its research program (see p.3). When NIST's Misakian asked Sivak if HEI would prohibit researchers from talking to the press before their work is peer-reviewed, Sivak replied, "We don't go public until our review process is done." He then said, "We'll have to think about it for our management in the future." HEI would not prevent an investigator from presenting data at a meeting prior to publication, he noted.

Sivak initially denied *Microwave News* permission to cover the June meeting, stating that he thought the presence of the press would inhibit "candid, open discussion" among the committee members (see *MWN*, M/J91). He later relented, putting the issue to a vote at the opening of the session. However, he indicated that the August 26-27 meeting, at which research priorities will be decided, would be closed.

A number of the committee members made presentations on EMF research efforts in the U.S. and in the U.K.: Dr. Larry Anderson on the Battelle Pacific Northwest Lab's programs; Dr. Gary Boorman of the National Institute of Environmental Health Sciences on the National Toxicology Program's upcoming animal studies (see *MWN*, S/O90); Dr. Brian Maddock of the U.K.'s National Grid Co. on research in the U.K.; Dr. Russel Reiter of the University of Texas Health Science Center, San Antonio, on his EMF–pineal and melatonin research; Dr. Bonnie Richter on the Department of Energy's plans for in-house epidemiological studies; Dr. Walter Rogers of the Southwest Research Institute on behavioral effects; Dr. Jeffrey Saffer of the Jackson Laboratory on cell and molecular experiments; Dr. David Savitz of the University of North Carolina on epidemiology; and Dr. Stan Sussman on the Electric Power Research Institute's programs.

HEI has received $525,000 from the Environmental Protection Agency, $125,000 of which will be used for the feasibility study. Sivak said that in the next fiscal year, HEI hopes to get $800,000-$1 million for research.

When feasibility committee member Dr. Martin Misakian of the National Institute of Standards and Technology (NIST) in Gaithersburg, MD, expressed concern over HEI's administrative costs, Sivak assured him that HEI's overhead will be about 12% (see p.9). Misakian suggested that HEI use the New York Power Lines Project as a model, citing the project's minimum overhead and good quality control.

HEI will hold a second meeting August 26-27 at its headquarters to review committee reports and to design a research strategy. Setlow, Sivak and Dr. Peter Valberg of Gradient Corp. will then draft a research proposal to take to the HEI board. Gradient Corp., also in Cambridge, is coordinating the feasibility study for HEI.

Sivak said that the feasibility committee's report and the independent advisory review will be published by HEI in late October or early November.

Parents Sue Utility Over Child's Kidney Cancer

A San Diego, CA, couple is suing San Diego Gas & Electric Co. (SDG&E), charging that electromagnetic fields (EMFs) from distribution and transmission lines caused their daughter to develop kidney cancer. In a suit filed on May 29 in California Superior Court in San Diego, Michelle and Ted Zuidema also contend that the power lines lowered the value of their house, which they sold in 1990.

The Zuidemas allege that their four-year-old daughter, Mallory, developed Wilms' tumor and nephroblastomatosis as a result of EMF exposure in utero. "Mallory Zuidema's fetal development was adversely affected, her cells and chromosomes were altered and she developed cancer," the suit charges. At approximately 26 months of age, Mallory had seven golf ball-sized tumors removed from her kidneys, according to one of the family's attorneys, Frederick Schenk of Casey, Gerry, Casey, Westbrook, Reed & Hughes in San Diego.

One side of the family's former home is about 15 feet from a 12 kV distribution line. Michelle Zuidema reportedly often slept on a sofa at the corner of the house closest to the line during her pregnancy. The house also is 80 feet from a right-of-way for five transmission lines (three 69 kV lines, one 138 kV line and one 230 kV line).

After measurements inside their home revealed magnetic fields of 3.5-17 mG, the Zuidemas moved from the house in early 1990 and sold it later in the year. The selling price was $150,000—$50,000 more than they paid in 1985 but $50,000 less than what they claim the house was worth. According to another of the Zuidemas' attorneys, Michael Withey of the Seattle, WA, firm of Schroeter, Goldmark & Bender, the family had notified prospective buyers of the EMF levels, in accordance with California laws. The house was sold to a group of investors led by Ted Zuidema's brother, and it now is being rented by a family with no young children.

Withey and Schenk are working on the case with Aaron Simon of Kazan, McClain, Edises & Simon in Oakland, CA. Withey and Simon are members of the Electromagnetic Radiation Case Evaluation Team (EMRCET), a national network of ten lawyers working on EMF-related cases (*see MWN*, M/A91).

The Zuidemas are seeking an unspecified award on the grounds of emotional distress, negligence, nuisance, product liability and trespass.

SDG&E responded on July 5 with a motion to dismiss the suit. The utility is arguing that the California Public Utilities Commission (PUC) has sole jurisdiction over power line EMF health effects: "The PUC's assertion of jurisdiction on the question of potential health effects associated with electric and magnetic fields is binding on the court and requires the dismissal of this action." The PUC is currently studying EMF health effects (see *MWN*, J/F91) and held a public hearing on July 26. A second hearing is scheduled for August 26 in San Francisco.

SDG&E also seeks dismissal on numerous technical grounds, including the allegation that the Zuidemas' suit was not filed until after the statute of limitations expired for several of the counts. According to the utility, Judge Ben Hamerick will rule on the motion on August 23 without hearing oral arguments from either side.

An SDG&E spokesman would not discuss the specifics of the suit. But in a telephone interview, John Dawsey, a senior environmental analyst with the utility, said that EMF biological effects are a "bona fide scientific issue," adding that nothing in the scientific literature would support the type of claim made by the Zuidemas.

John Britton of SDG&E's public relations office said that more than half of the calls and letters he receives about EMFs are concerned with property values.

Alabama Family Seeks $750 Million for EMF Risks

A family is seeking $750 million from the Alabama Power Co. for physical injury, risk of cancer, mental anguish and punitive damages. Johnnie and Sharon Allen, whose property is traversed by a 230 kV transmission line which was built in 1989, contend that the utility intentionally misled them into believing that reports of health risks from EMFs were unfounded.

In their suit, filed May 3 in the Circuit Court of Jefferson County, AL, the Allens charge that Alabama Power "has engaged in a pattern and practice of concealing the dangers of EMFs from them and from the public generally." The Allens are being represented by Bill Thomason of the Bessemer, AL, law firm Paden & Thomason, and Clay Ragsdale of the Birmingham, AL, law firm Starnes & Atchison.

Alabama Power, in a written response to interrogatories from the Allens' lawyers, states that, "It is our understanding that the preponderance...of the credible scientific evidence does not support any cause–effect relation between exposure to [extremely low frequency] EMFs and health problems." The utility filed its response on June 24.

The Allens built their home in September 1987. In August 1988, Alabama Power began condemnation proceedings after the two sides were unable to reach an agreement on the sale of land that the utility wanted to use for a right-of-way. During their negotiations, according to the Allens, a utility official told Johnnie Allen that "the claims made by the super environmentalists and liberals that the transmission lines presented a danger were entirely frivolous" and that he should not be concerned about them.

The suit argues that the utility is liable for negligence, loss of property value, emotional distress, nuisance, fraudulent concealment of its knowledge of EMF risks and strict liability. In addition, the Allens are seeking an injunction to stop the operation of the line.

Australia and U.K. To Begin Major Childhood Epi Studies

Researchers in Australia and in the U.K. will soon start large-scale epidemiological studies on the possible link between power line electromagnetic fields (EMFs) and childhood cancer.

In Australia, Dr. Michael Repacholi of the Royal Adelaide Hospital will coordinate a study for the Australian Radiation Laboratory in Yallambie. The study will include 500-1,000 cases of all types of childhood cancer, with special emphasis on brain tumors and leukemia, Repacholi told *Microwave News*.

The Electricity Commission of New South Wales will sponsor the study, which is expected to cost $1.5 million (Aus.)—about $1.2 million U.S.—and to take three to five years to complete.

"This effort is a response to the Gibbs inquiry's recommendation for more research," Repacholi said. In February, Sir Harry Gibbs, a former High Court Chief Justice, concluded that the link between EMFs and health effects is inconclusive but recommended prudent avoidance and more research (see *MWN*, M/J91).

In the U.K., the Coordinating Committee on Cancer Research, based in London, is developing its own childhood cancer–EMF epidemiological study, according to Dr. Brian Maddock of The National Grid Co. This study "is still in the planning stages," Maddock told *Microwave News*.

The National Grid Co., which operates the transmission lines in the U.K. and is based in Leatherhead, will assist with the study's magnetic field measurements, and the National Radiological Protection Board will play a technical role, Maddock said.

In an epidemiological study published in late 1990, Dr. A.D. Clayden and coworkers at the U.K.'s University of Leeds reported finding no association between EMFs and childhood cancer, though the exposures were extremely low—below 0.1 mG (see *MWN*, J/F91).

State and Local EMF Actions: Recent Developments

Connecticut...Senate Majority Leader Cornelius O'Leary's SB 633, mandating that public utilities contribute $150,000 to the state's EMF Task Force, passed both branches of the legislature and was signed into law by Governor Lowell Weicker on June 25. The funds will be used to hire experts to develop a policy of prudent avoidance and for an EMF literature review to set state research priorities (see *MWN*, M/J91). The task force must submit an interim report to the legislature by February 1, 1992.

Oregon...The House of Representatives and the Senate approved Senator Grattan Kerans's SB 861 by votes of 57-1 and 21-0, respectively, and Governor Barbara Roberts signed it on July 11. The bill requires the state's Energy Facility Siting Council to form a committee of representatives from the public, utilities and government to monitor EMF research and to report back to the council and to the legislature (see *MWN*, M/J91). The law will take effect on September 29.

Rhode Island...The proposed statewide three-year moratorium on construction of transmission lines above 60 kV, introduced by Rep. Steve Hernandez (H-5016) and by Senator Michael Lenihan (S-26), passed 74-1 in the House of Representatives, but was tabled by the Senate. Despite this setback, the bill "probably had the support to pass the Senate if it had come to a vote," Hernandez told *Microwave News*. He said that the bill will be reintroduced in the next legislative session, which starts in January. On July 2, Governor Bruce Sundlun announced that a newly appointed EMF task force, chaired by Scott Wolf, an aide to the governor, will consider the moratorium. Meanwhile, RI Superior Court Judge Patricia Hurst has stayed her decision to nullify a local power line moratorium in East Greenwich, and the case will be heard by the state Supreme Court. Until the high court ruling, which is not expected until next year, the Narragansett Electric Company will be forced to delay construction of the East Greenwich portion of a new 115 kV line, a company spokesman told *Microwave News*. (See also *MWN*, N/D90, J/F91 and M/J91.)

HIGHLIGHTS

SAB Panel Calls for Rewrite of EPA EMF–Cancer Report

The Environmental Protection Agency's (EPA) draft report on cancer and electromagnetic fields (EMFs) has "serious deficiencies and should be rewritten," an EPA Science Advisory Board (SAB) panel has recommended. At the same time, the panel members issued a unanimous statement that the question of EMF biological effects is "important and exceptionally challenging."

As expected, the members of the SAB's Non-Ionizing EMF Subcommittee asked EPA to tone down its conclusion that EMFs are a "possible, but not proven, cause of cancer in humans." Instead, they counseled that, "Currently available information is insufficient to conclude that [EMFs] are carcinogenic."

By the end of its third—and final—meeting, held July 23-25 in Crystal City, VA (outside of Washington, DC), the SAB panel had completed its review of EPA's draft report, *Evaluation of the Potential Carcinogenicity of Electromagnetic Fields*, for EPA Administrator William Reilly. Previous meetings were held in January and April (see *MWN*, J/F91 and M/J91).

EPA's Dr. Robert McGaughy, the principal author of the EPA cancer report, called the panel's advice "comprehensive and very authoritative." In an interview, he said that, "We're really pretty much in agreement with their evaluation." EPA sources told *Microwave News* that rewriting the report could take up to a year.

While the panel paid the most attention to power frequency EMFs, the members issued a special warning on radiofrequency and microwave (RF/MW) radiation "hazards," recommending that EPA resume work on its stalled RF/MW exposure guidelines (see *MWN*, S/O88 and box on p.8).

Among the other conclusions reached by the panel were:

- The carcinogenicity of EMFs should not be classified using the system devised for chemicals because of "major uncertainties."

• "There is insufficient information to designate specific values of magnetic field strength that may be hazardous to human health."
• "The epidemiological evidence is suggestive of an association between surrogate measurements of magnetic field exposure and certain cancer outcomes." But the lack of clear exposure information and of an understanding of key exposure parameters combined with a limited understanding of potential mechanisms "weakens the inference of cancer causality from these associations."
• The incidence of cancer may be affected by non-mutagenic agents which do not interfere directly with DNA—for example, hormone imbalances caused by disruptions in the pineal gland's melatonin cycle (see *MWN*, J/A90).
• "If effects on living systems at lower fields do occur, the assumptions leading to estimations of physical constraints for effects on isolated small spherical cells...may not be applicable to larger cells or cell systems such as neurons or neuronal networks."

Several panel members raised other concerns:
• Dr. Genevieve Matanoski of Johns Hopkins University in Baltimore, MD, the chair of the panel, noted that EPA should have integrated the human epidemiological data and the biological data to reach general inferences about EMF risks.
• Dr. Bary Wilson of the Battelle Pacific Northwest Lab in Richland, WA, emphasized the importance of exposure parameters such as transients and time-varying fields, arguing that the issue should be brought directly to the attention of the EPA administrator and not be buried in the report.
• Prompted by the public testimony, Dr. Nan Laird of the Harvard University School of Public Health in Boston, MA, pointed out that neither the subcommittee report nor EPA's research

SAB Conclusions and Recommendations on EPA's EMF–Cancer Report

The SAB's EMF panel is finalizing its critique of EPA's EMF–cancer report. The following excerpts include revisions made at the July 23-25 meeting.

Currently available information is insufficient to conclude that [EMFs] are carcinogenic. Human epidemiologic data report an association between surrogates for [EMF] exposure and an increased incidence of some types of cancer, but the conclusion of causality is currently inappropriate because of limited evidence of an exposure–response relationship and the lack of a clear understanding of biologic plausibility....

Some of the in vitro and in vivo data on unmodulated RF have suggested the existence of mechanisms by which human health effects, but not carcinogenicity, may be inferred. Both unmodulated and ELF-modulated RF fields of sufficient intensity can give rise to thermal effects. Non-thermal biological effects also have been reported in animals exposed to RF fields. It is well established that in vitro and in vivo experiments on ELF have shown non-thermal biologic effects at fields of moderate intensity and there are suggestive effects at lower levels. Furthermore, ELF-modulated RF fields assumed to be non-thermal can produce many of the biological effects of ELF fields alone. Hypothetical constructs relating observed biological effects to possible health effects (specifically, increased cancer risk) have been delineated. However, there are at present insufficient data on many of the critical steps in the linkage to infer causality on the basis of animal or cellular data....

[T]he EPA has not evaluated how the findings on biological effects and non-ionizing field and tissue interaction mechanisms relate to the interpretation of human studies. The strength of epidemiologic data depends on identification of supporting evidence from in vitro and in vivo data. This has not been developed in the report. The critiques of studies of biological effects are contained in the discussions of the several chapters....

The heading of chapter 5, *Supporting Evidence of Carcinogenicity*, is inappropriate. The interpretation of the biological effects in the in vitro systems as presented by the report does not make a case for carcinogenicity. Specific individual experiments need critical review....

Non-ionizing [EMFs] should not be classified together under the EPA's chemical carcinogenesis system because of present major uncertainties. These involve an incomplete understanding of which aspects of field–tissue interactions give rise to biological effects. Properties of the various [EMFs] such as phase angle, polarization, transients and frequency range may contribute to different biologic effects. For these reasons, the use of the EPA's classification scheme at this time would be inappropriate and confusing....

There is insufficient information to designate specific values of magnetic field strength that may be hazardous to human health for two reasons. a) There is insufficient evidence from the human epidemiology data and from animal/cell experiments to establish unequivocal cause-and-effect relationships between low frequency EMF exposure and human health effects and cancer. b) The precise nature of the environmental low frequency EMFs potentially related to human disease remains to be elucidated. In addition to field strength, parameters such as the time-varying nature of the magnetic fields and the relevant time/exposure parameters need to be determined.

The subcommittee also wishes to express two specific policy recommendations that in its view follow inescapably from the scientific recommendations....:

Policy Recommendation No.1: The subcommittee is unanimous in its belief that the question of [EMF] effects on biological systems is important and exceptionally challenging; and that the subcommittee's advice to the EPA should be that the report should be rewritten by EPA, and then rereviewed by the Science Advisory Board.

Policy Recommendation No.2: EPA should complete its efforts with regard to RF [EMFs] (including [MWs]) and issue exposure guidelines independent of present issues pertaining to lower frequencies. The current EPA report inadvertently leads even the careful reader to conclude that the potential carcinogenicity of [EMFs] of ELF (i.e., power line) frequencies is the only—or at least the principal—subject of concern with regard to non-ionizing fields. Such a conclusion would reinforce the skewed and somewhat sensationalized picture presented to the public in recent years by the news media and government agencies responding to this publicity. The report should therefore declare explicitly that the attention given to non-ionizing [EMFs] derives in the first place from long-standing concern over the hazards of RF (including [MW]) radiation. EPA has expended substantial resources on the study of such radiation over a period dating back to the EPA's inception, and EPA should complete its efforts directed toward the issuance of RF exposure guidelines. RF fields present long-known and well-understood hazards against which users and the general public must be warned and protected.

Childhood Brain Tumor Cluster in West Virginia

Five children living near a 345 kV transmission line have developed brain cancer in the last two years, according to Dr. Martha Gelderman, a family practitioner in Union, WV. In a presentation to the SAB panel, she pleaded for assistance. "We have nowhere to turn for help," she said.

Gelderman said that the five cases occurred in a rural school district serving 1,000 children. SAB panel Chair Dr. Genevieve Matanoski, an epidemiologist, called the numbers "overwhelming."

People are staying home at night reading the EPA EMF–cancer report looking for answers instead of watching television, Gelderman told the panel. "They're afraid for their children," she said. She urged the subcommittee to help "humanize" the report and called for a clearinghouse where average citizens could get accurate information.

Dr. Gayle Sharp, also from Union, told *Microwave News* that there are transformers outside of every home in the rural area and that there are three transformers within 50 feet of the home of a 12-year-old girl who recently died of brain cancer. Sharp added that the community is trying to stop a proposed 765 kV line.

A growing number of studies have linked EMF exposures at home and at work to the development of brain tumors (see *MWN*, M/A90).

agenda adequately address the public's concerns. She argued that it is "irresponsible" to say that there is something to investigate without providing guidance. Many panelists agreed that EPA should issue a citizen's guide on EMF risks. In a statement, John Rice and Sandy Travis of Annapolis, MD, who had blocked the expansion of an electrical substation, noted that EPA's draft report was essentially the only guidance they had.

• Matanoski and Dr. Charles Susskind of the University of California, Berkeley, both spoke in favor of a government-coordinated national research program. "You're not going to solve the problems of public perceptions until you put the research into the hands of the National Institutes of Health," Matanoski said. Susskind pointed out, "It would be far better for this work to be coordinated by a government agency such as the National Institute of Environmental Health Sciences."

Near the end of the meeting, some panelists expressed reservations about the prospect of the Health Effects Institute's (HEI) proposed public–private research effort (see pp.3 and 5). "HEI has absolutely inadequate experience and credentials" in EMF research, Bary Wilson said. Susskind noted that HEI's overhead costs would take a "substantial bite" out of the research budget.

In an attempt to allay these concerns, HEI's Dr. Andrew Sivak stated that HEI's strength lies in its ability to "bring together and work with key people in the field" rather than "in our knowledge and experience." He said that the institute's overhead is about 14% (see p.5).

Speaking in support of HEI, panelist Dr. Granger Morgan of Carnegie Mellon University in Pittsburgh, PA, argued that EPA has had "extraordinary difficulty" in sustaining its research efforts, and that HEI would provide a "buffer" enabling the agency to engage in long-term research. He noted, however, that he would not want the HEI project to divert funds from existing federal EMF programs. "I will be very unhappy about that outcome," he said.

The last panel meeting, originally scheduled for September 9-10, has been canceled. Although some of the revisions were not finalized, the panel will complete its work by mail. (For a complete list of the members, see *MWN*, M/J91.)

The SAB Radiation Advisory Committee (RAC), the panel's parent group, will consider the panel's report at a September 20 meeting. If the RAC gives its approval, the SAB executive committee will review the report at its October 29-30 meeting.

SAB Panel Critical of EPA's EMF Research Strategy

The Environmental Protection Agency's (EPA) plan for research on electromagnetic field (EMF) effects drew a barrage of criticism when it was released to members of the agency's Science Advisory Board (SAB) EMF panel at a July 23-25 public meeting in Crystal City, VA.

The report, *A Research Strategy for Electric and Magnetic Fields: Research Needs and Priorities*, lists 32 specific recommendations for future studies. It was prepared at the request of EPA Administrator William Reilly by a working group under the direction of Dr. Joe Elder of EPA's Health Effects Research Laboratory in Research Triangle Park, NC. The strategy was intended as a companion to the EPA EMF–cancer report, which is being reviewed by the SAB panel (see p.7).

EPA assigned the highest priorities to research on cancer, biophysical mechanisms of interaction and exposure assessment. Studies of reproductive and developmental effects as well as of nervous system effects were labeled as "medium" priorities, with research on immune system effects and control technology as "low" priorities.

Many of the SAB panelists argued that the research recommendations are too sweeping and lack focus. "It's not a useful document," said Dr. Richard Wilson of Harvard University in Cambridge, MA. "I think the only thing missing is lower back pain," commented Dr. Kelly Clifton of the University of Wisconsin, Madison.

The panel members charged that EPA has failed to explain how the research would be done. "While the document as it stands is not a work plan, the broad implementation of EPA's research agenda should be delineated," said Dr. Karim Ahmed of Princeton, NJ. "They must address implementation," agreed Dr. Genevieve Matanoski of Johns Hopkins University in Baltimore, MD, the chair of the SAB panel.

A number of the SAB panelists asked why EPA has not been

more explicit about its role and that of the Health Effects Institute (HEI) (see pp.3 and 5). "Who is intended to do the research?" asked Dr. Mary Ellen O'Connor of the University of Tulsa, OK, noting that, "EPA has no [EMF] research program." Dr. Charles Susskind of the University of California, Berkeley, wondered aloud why the draft says nothing about implementation when it was clear that "considerable thought [had] already [been] given to it at EPA."

Dr. Ken Sexton, the director of EPA's Office of Health Research, tried to defuse the criticism by suggesting an alternative title for the report: *A Research Domain for [EMFs]: Research for Health Effects from an EPA Perspective.* He later explained that, "We made a serious mistake by not clarifying that the nature of the document had changed during the [development] process." He said that "no decision has yet been made" as to whether EPA or some other organization, such as HEI, would do the research.

Many senior EPA officials clearly see the research report as controversial. In a June 26 presentation on the EPA strategy at the Bioelectromagnetics Society meeting in Salt Lake City, UT, portions of Elder's slides were deleted, even though the report had already been printed and was ready for distribution.

Susskind, who was a member of a previous SAB panel on radiofrequency and microwave (RF/MW) radiation health effects, observed that that panel had also assembled a research strategy in 1984 (see *MWN*, J/F84). "We haven't heard anything since then—I wish you good luck with your current strategy," he told Sexton in Crystal City.

Dr. Granger Morgan of Carnegie Mellon University in Pittsburgh, PA, called the draft "a C- effort that could be edited [at best] into a C+." He recommended that, "The document needs to place a greater emphasis on the importance of developing a basic scientific understanding [of EMF interactions]." Dr. Clark Heath of the American Cancer Society in Atlanta, GA, also argued that EPA should emphasize "the more fundamental and far-reaching need of furthering our basic understanding of biologic effects and mechanisms. Without such basic knowledge, research regarding cancer risks and exposure parameters is likely to remain shallow."

The report addresses EMFs up to 500 kHz: "Although exposure to EMFs at frequencies above [500 kHz] is also a health concern, the lower range is emphasized because of the heightened concern for possible health effects from exposure to 60 Hz EMFs from power lines and to commonly used devices in the home and workplace...." EPA states that the draft report comes in response to "widespread media attention" and "public and private concerns."

Some of the research priorities listed by EPA are:

- Evaluation of confounding factors which may distort the EMF–health effects association suggested in epidemiological studies.
- Examination of populations exposed to other than electric power frequency (50/60 Hz) EMFs.
- Animal research to determine whether EMFs can induce cancer.
- Studies of EMF effects on the behavior of laboratory animals, emphasizing learned tasks and drug interactions.
- Confirmation of EMF effects on immune response in vitro.
- Analysis of EMF interactions to determine whether biological effects are due to currents induced by time-varying magnetic fields, and whether currents induced by electric fields have categorically different effects than those produced by magnetic fields.
- Development of models of possible mechanisms of interaction, including evaluation of exposure characteristics reported to have therapeutic action in biological systems.
- Identification of sources of electric and magnetic field exposures.
- Training of individuals responsible for field measurements and the development of measurement protocols.
- Three-dimensional maps to characterize EMFs from residential appliances and industrial equipment.
- New materials to shield magnetic fields and mitigate exposures.

Canada Issues RF/MW Exposure Standard

The Canadian government has published its revised limits for occupational and public exposures to radiofrequency and microwave (RF/MW) radiation in the 10 kHz-300 GHz range. The standard includes limits for contact currents for frequencies between 10 kHz and 30 MHz.

Like the 1982 American National Standards Institute (ANSI) RF/MW guidelines, the Canadian exposure limits change as a function of frequency—forming the now common "well shape." For workers, the strictest limit is 1 mW/cm^2 from 30-300 MHz, rising to 5 mW/cm^2 at 1.5 GHz and above. At the lower frequencies 10 kHz–1 MHz, the electric and magnetic field limits are 600 V/m and 4.9 A/m, respectively. For the general public, maximum power density limits are five times lower—200 μW/cm^2 from 30-300 MHz and 1 mW/cm^2 from 1.5-300 GHz. At 10 kHz-1 MHz, the limits are 280 V/m and 2.19 A/m.

The maximum allowable contact currents are, for occupational exposures, 400f mA for 10 kHz-100 kHz and 40 mA for 100 kHz-30 MHz and, for the general public, 150f mA and 15 mA in the two frequency ranges, respectively, where f represents frequency in MHz.

Portable transmitters operating below 1 GHz with an output power of seven watts or less are exempt from the limits.

The standard has been simplified since it was first proposed in 1987 (see *MWN*, S/O87 and N/D87). For instance, there are now fewer frequency ranges—but the safety levels are essentially the same, according to Dr. Maria Stuchly, who developed the standard for Health and Welfare Canada.

The new standard is intended for use by federal agencies. But David Charron of the Ontario Ministry of Labor's Radiation Protection Service told *Microwave News* that several provincial governments may also adopt it.

Limits of Exposure to Radiofrequency Fields at Frequencies from 10 kHz-300 GHz (Safety Code 6) is available for $4.95 (Cdn), $5.95 (U.S.) from: Canada Communication Group–Publishing, Ottawa, Ontario K1A 0S9, Canada, (613) 956-4802. The catalog number is H46-2/90-160E.

FROM THE FIELD

Medical Microwaves in Yugoslavia

The 1st International Scientific Meeting: Microwaves in Medicine '91 *was held April 8-11 in Belgrade, Yugoslavia. The conference was conceived by the Yugoslav chapter of the Institute of Electrical and Electronics Engineers' (IEEE) Microwave Theory and Techniques Society (MTT-S) and organized jointly by the MTT-S, the Scientific Committee of Serbia and the Institute of Microwave Techniques and Electronics (IMTEL), based in Belgrade. The following report was prepared for* Microwave News *by IMTEL's Branka Jokanovic, Dr. Stanislaw Szmigielski of the Center for Radiobiology and Radiation Safety in Warsaw, Poland, and Professor Roberto De Leo of the University of Ancona, Italy. A limited number of copies of the 304-page conference proceedings are available for $65.00 (U.S.) each from: Branka Jokanovic, IMTEL, Bulevar Lenjina 165b, 11070 Belgrade, Yugoslavia, (38+11) 135420, Fax: (38+11) 138928.* *See also p.14 for details of a conference on millimeter waves in medicine to be held in Moscow in September.*

About 100 participants from Belgium, Bulgaria, Czechoslovakia, Hungary, Italy, Japan, Poland, South Africa, the U.S., the U.S.S.R. and Yugoslavia attended the conference, which featured five invited presentations and 42 papers. There were sessions on medical applications of microwaves, dosimetry and instrumentation, biological effects, health hazards and safety standards and the use of polarized light. The meeting also included a roundtable discussion of electromagnetic compatibility techniques led by Professor De Leo, and a review of potential medical applications of printed antennas led by Professor Aleksandar Nesic of IMTEL. The last two sessions were made possible by the Italian Embassy in Belgrade and mark the first step toward greater cooperation between Italy and Yugoslavia in this area.

An invited paper, "Microwave Acupuncture as Stimulus for the Interaction Between Electromagnetic Fields (EMFs) and the Nervous System," by Professor Andre Vander Vorst of the Catholic University of Louvain in Louvain-la-Neuve, Belgium, as well as a series of papers from the U.S.S.R., described the use of millimeter waves (40-80 GHz) to stimulate acupuncture points, a technique based on traditional Chinese medicine. According to Mikhail Golant and Vera Nadejeva from RPA "Istok" in Moscow, this form of acupuncture is widely used in the U.S.S.R., where 40,000 patients with conditions ranging from stomach polyps, duodenal ulcers, arterial hypertension and angina pectoris to traumas and advanced neoplasms have been treated using commercially available devices. Despite the excellent results claimed by the Russian researchers, this form of nonconventional therapy cannot be evaluated in terms of modern medicine, because, according to Drs. Yuri Kholodov and Natalia Lebedeva of the Institute of Higher Nervous Activity and Neurophysiology at the U.S.S.R. Academy of Sciences in Moscow, there are presently no accepted mechanisms of interaction between millimeter waves and the central nervous system.

Yugoslav, Czech and South African engineers have developed several interesting devices using microwave energy. For instance, Dr. B. Downing of the University of Cape Town, South Africa, has designed a low-cost microwave system, operating at 2.45 GHz, for deactivating HIV—the virus associated with AIDS—in breast milk collected to feed premature newborns. And Dr. Slobodan Manola and coworkers at the Institute of Physics in Belgrade presented a way of using microwave-induced low-energy gas plasmas to sterilize medical instruments and plastic items at 75-80° C.

Professor Paul Walinsky of the Department of Medicine at Thomas Jefferson University Hospital in Philadelphia, PA, reported that microwave balloon angioplasty of the coronary and peripheral blood vessels is a promising form of therapy for atherosclerotic vascular disease. In his invited talk, he concluded that microwave angioplasty is more effective than conventional angioplasty in maintaining vascular patency in the presence of thrombus.

The treatment of an enlarged prostate using microwave hyperthermia was addressed by Dr. Hyder Arastu and associates at the Albert Einstein Medical Center in Philadelphia, PA, in their invited lecture, "The Efficacy of Transurethral Interstitial Microwave Hyperthermia in the Management of Benign Prostatic Hyperplasia [BPH]," and by Dr. Bronislaw Stawarz and colleagues at the MMA Postgraduate Medical School in Warsaw, Poland, in a paper on the treatment of BPH with intrarectal and intraurethral microwave applicators. The two presentations indicated that intraurethral microwave hyperthermia in advanced BPH is an efficient and safe alternative to surgery.

With respect to microwave hyperthermia, Dr. Branko Kolundzija of the University of Belgrade, Yugoslavia, presented a mathematical model for plotting energy deposition and temperature distributions, and Drs. Yoshio Nikawa and Fumiaki Okada of Japan's National Defense Academy in Yokosuka described an innovative applicator. In addition, Dr. Evgeni Khizhnyak of the Institute of Cell Biophysics of the U.S.S.R. Academy of Sciences in Pushchino and a group led by Professor Fernando Bardati of the University of Rome, Italy, described non-invasive techniques to map heating during hyperthermia. The dielectric properties of biological tissues were described from a theoretical point of view by Dr. Salvatore Caorsi and coworkers at the University of Genoa, Italy, and from an experimental point of view by IMTEL's Dr. Veljko Napijalo and Branka Jokanovic.

In a series of three papers, Dr. Zdravko Stojanovic of the Institute of Aviation Medicine in Belgrade, Drs. Zoran and Milan Djordjevic of the Pacemaker Center at the University Clinical Center in Belgrade and Dr. Zdravko Kelecevic, also of the Institute of Aviation Medicine, described their work on microwave-induced health effects and protective clothing. Stojanovic, a medical doctor, presented the results of a clinical study of 253 radar operators which showed a higher incidence of irregularities in the lymphocytes and the nervous systems of workers chronically exposed to microwaves.

In a review of the possible link between EMFs and cancer, Dr. Stanislaw Szmigielski concluded that EMFs should be classified as "possible" carcinogens.

Dr. Zlatko Koren of the Department of Electrical Engineering at the University of Zagreb, Yugoslavia, recently received a grant of 3.4 million ECU [European Currency Units—approximately $4 million, U.S.] from the Committee of Science and Technology of the European Community to coordinate bioelectromagnetic research in European countries and to establish common safety standards for all European countries. The research project is expected to take four years, beginning with a series of workshops to plan for international cooperation in epidemiological, medical and experimental studies related to the biological effects of non-ionizing radiation. Prospective epidemiological studies of cancer morbidity, as well as medical examinations of personnel occupationally exposed to radiofrequency and microwave radiation, are being planned for this effort.

The Belgrade meeting, the first conference on microwave applications in medicine, was an opportunity to introduce recent developments in this field. The organizers hope that it will stimulate further research, particularly because this field is potentially one of the most important for nonmilitary uses of microwave technology.

The *2nd International Scientific Meeting: Microwaves in Medicine '93* will be held in Italy. Those interested in attending should contact Professor Roberto De Leo, University of Ancona, Via Brecce Bianche, 60131 Ancona, Italy, Fax: (39+071) 2204 835.

cancer promotion hypothesis.

"The study is important and interesting and could be very significant," Dr. Leonard Sagan told *Microwave News* after the BEMS meeting. Sagan, the program manager for radiation studies at the Electric Power Research Institute (EPRI) in Palo Alto, CA, said that he was reluctant to offer a detailed opinion, given that the results are preliminary and that the number of animals involved was small.

"This copromotion study is potentially highly significant," observed Dr. Craig Byus of the University of California, Riverside, who is a member of the Environmental Protection Agency's (EPA) Science Advisory Board (SAB) panel that is reviewing EPA's EMF cancer assessment (see p.7). Byus added that, "It may be that you can see the EMF effect more clearly in the copromotion model than through straight promotion—both approaches should continue to be pursued." Dr. Bary Wilson of the Battelle Lab in Richland, WA, another SAB panelist, agreed: "If this study continues to be positive, it will change the playing field."

Synergy between chemicals and ELF EMFs has been the subject of increasing attention over the last few years. In a recent review paper on experiments with both ELF EMFs and ELF-modulated microwaves, Dr. Ross Adey, in whose lab Cain works, noted that, "Bioelectromagnetic research reveals clear evidence of joint actions at cell membranes of chemical cancer promoters and environmental [EMFs]. The union of these two disciplines has resulted in the first major new approach to tumor formation in 75 years" (see *MWN*, N/D90).

McLean and Stuchly, in collaboration with Dr. Ronald Mitchel of Atomic Energy of Canada in Chalk River, Ontario, painted the skin of 96 female mice with DMBA, a known cancer initiating agent, and soon afterwards treated 48 of them with 0.3 μg TPA and the other 48 with the TPA and a 20 G, 60 Hz magnetic field. The TPA was applied once a week and the field was turned on for six hours a day, five days a week. After 17 weeks, there were more than three times as many mice with tumors—a statistically significant increase—among those exposed to the TPA–magnetic field combination than in the mice only treated with TPA. There was a similar and equally significant increase in the number of tumors per mouse. The exposures are continuing—"It is still too early to say what the actual findings will be," Stuchly said in an interview at the BEMS meeting.

Indeed, as *Microwave News* goes to press, Stuchly reports that, after 23 weeks of exposure, the mice only exposed to TPA had developed more tumors and that the differences between the two groups were no longer statistically significant. Nevertheless, the number of mice with tumors and the number of tumors per mouse were still higher in the TPA–EMF-exposed group. "It appears that the field accelerates the tumor development process," Stuchly said in late July. She also noted that there was considerable variation in the number of tumors per animal. "Some mice had only one tumor, while others had up to 20," she said.

In a previous study, the Canadian team exposed mice to the 60 Hz magnetic field without TPA, after using DMBA to initiate cancer, but found no change in tumor development. Those results have been accepted for publication in a future issue of *Bioelectromagnetics*. Similar studies in Sweden by Dr. Bo Holmberg and coworkers at the National Institute of Occupational Health in Solna have also failed to show a promotional effect of a 50 Hz magnetic field—without TPA—in the development of skin cancer in mice.

"I'll breathe easier when our study is replicated both in our lab and in another lab," McLean said. Indeed, the Health and Welfare team is not waiting for the experiment to be completed before planning a new set of exposures. McLean and Stuchly said that they will begin repeating the study in September and plan future experiments with lower exposures—5 G and/or 10 G—in an effort to determine a dose–response relationship. "If the effect is real, we must know where the threshold for the magnetic field effect is," Stuchly said, adding that she would also like to test the response of the mice exposed to an intermittent field—for instance, one that turns on or off every 15 minutes.

The Canadian researchers are also investigating the mice's immune response as part of the same study. These results were not ready for release at the BEMS meeting. In their earlier study, they showed a statistically significant decrease in natural killer (NK) cell activity among mice exposed to TPA and 60 Hz fields. Those findings suggest that "the magnetic field may affect tumor growth by suppressing an immune surveillance system (NK cell activity) that would otherwise prevent or retard the growth of some tumor or leukemia cells."

Dr. Stanislaw Szmigielski of the Center for Radiobiology and Radiation Safety in Warsaw, Poland, previously reported synergistic effects between microwave radiation and benzopyrene on the development of skin tumors in mice (see *MWN*, My81 and J/A82).

Cain's cellular findings parallel the Canadian animal results: The magnetic field enhanced the action of the TPA. Cain used a co-culture of two different cell types: C3H10T1/2 fibroblasts and mutant cells—offspring of the fibroblasts that had been transformed by UV radiation. When these two cell types are grown together in the same dish, they coexist as a monolayer, but in the presence of TPA the harmony is lost and the cancer cells grow on top of one another. "Essentially, the parent cells keep the daughters in line," Cain explained to *Microwave News*. "When you add TPA, the daughter cancer cells pile up." Cain found that the number of cancer cells doubled when the co-culture was exposed to both TPA and a 1 G, 60 Hz magnetic field for one hour every six hours, every day for four weeks—as compared to TPA exposure alone.

Both Cain and Stuchly agreed that their findings are complementary. "They are two pieces of the same puzzle," Cain said. "They point in the same direction," Stuchly concurred.

In a series of experiments, Drs. Elizabeth Balcer-Kubiczek and George Harrison of the University of Maryland School of Medicine in Baltimore have shown that ELF-modulated microwaves and chemicals can initiate cancer in normal cells (see *MWN*, J/A89). "These new co-promotion results coupled with those from our lab indicate that the carcinogenicity of EMFs must be taken very seriously," Balcer-Kubiczek told *Microwave News*.

and Cory Davis of Corpus Christi, TX, sued Aequitron Medical, Inc., of Minneapolis, MN, after their infant son died—an Aequitron Model 8200 monitor had failed to warn them that the child had stopped breathing. The terms of the March 1990 out-of-court settlement were not disclosed.

"The lawsuit contended that EMI was a major factor in the failure of the monitor and that the manufacturer failed to adequately warn of any potential problem," Cage Wavell, the Davises' Corpus Christi-based attorney, told *Microwave News*. The family lived in an apartment building several miles from the Corpus Christi Naval Air Station. Wavell noted, however, that in the absence of detailed measurements, EMI from household appliances, particularly an electric fan near the infant's bed, could not be discounted.

"The company knew for years that the monitors had alarm problems and that many babies had probably died," the Davises told a congressional subcommittee chaired by Rep. Henry Waxman (D-CA) at a November 1989 hearing in Washington, DC. Depositions from the Davis case indicate that Aequitron knew of the EMI problem as early as 1983, Wavell said. In the course of the litigation, the company provided documentation of several hundred failures of Aequitron monitors, he said.

A May 1990 GAO report to the subcommittee, *Underreporting of Serious Problems with a Home Apnea Monitor* (GAO/PEMD-90-17), reproduced one Aequitron document linking the Model 8200 to 68 deaths from 1983 through 1989. A GAO examination of company records revealed at least two other allegations of fatalities. Prior to the GAO investigation, the company had reported only five deaths associated with the monitor to the FDA, however.

When contacted by *Microwave News*, Aequitron refused to comment other than to say that the Davis suit had been settled.

Apnea monitors measure cardiorespiratory activity through electrodes attached to a patient's chest. Laboratory studies and field surveys of eight models made by four manufacturers "demonstrated that EMI can cause disruption of apnea monitors at relatively low field strengths and at common communication frequencies," according to an FDA report, authored by Paul Ruggera and Eugene O'Bryan, which will be presented at the Institute of Electrical and Electronics Engineers' (IEEE) *Annual Meeting of the Engineering in Medicine and Biology Society* in late October.

In the lab, the alarm of the most sensitive model failed when exposed to fields below 0.1 V/m at FM broadcast frequencies (88-108 MHz). Other models were found to be sensitive to very high frequency (VHF) television signals (54-88 and 174-216 MHz). Every monitor tested registered false breaths and heartbeats—which could prevent the alarm from sounding—at relatively low field strengths, according to the FDA researchers.

Field tests at 15 sites in Washington, DC, Omaha, NE, and Portland, OR, generally confirmed the lab results. At one location more than a mile from the nearest FM radio transmitter, with a maximum single signal of 1.7 V/m, erroneous breaths and heartbeats were detected by most monitors, they reported.

Based on these results and on RF measurements in several U.S. cities by the Environmental Protection Agency, the FDA concluded that a "significant percentage of the U.S. population lives in areas likely to experience EMI levels that could interfere with the most sensitive of these apnea monitors." A preliminary report on the FDA's findings appeared in the April issue of *Radiological Health Bulletin* and in the May issue of *Medical Devices Bulletin*, both published by the CDRH.

Though RF broadcast signals are the major focus of concern, an FDA "Safety Alert" titled *Important Tips for Apnea Monitor Users* warns that EMFs from electrical appliances or cellular telephones could affect the devices, and that even "draperies or rugs...can also cause interference with the monitor due to static electricity."

This fall, the FDA will circulate the third draft of a technical standard for apnea monitors, which will include an extensive section on EMI. A final standard is not expected for at least another year, however. Though many manufacturers are already redesigning or retrofitting their devices to address the problem, a recall is still possible, a knowledgeable source at the FDA told *Microwave News*.

A working group of the International Electrotechnical Committee proposed a 3 V/m immunity requirement for medical devices from 26 MHz to 1 GHz in a December 1990 draft, *Medical Device Electromagnetic Compatibility Standard*.

EMI to medical devices has been the subject of increasing concern over the last few years (see *MWN*, S/O85, N/D85, M/J88, S/O88 and M/A90).

UPDATES

GOVERNMENT

Radiation Control Directors... Recent research findings on ELF EMFs and cancer "must compel the urgent attention of the radiological health community." This was the warning issued by Dr. Leonard Solon, who recently retired as the director of the New York City Bureau for Radiation Control, to participants at the *23rd Annual Meeting of the Conference of Radiation Control Program Directors* (CRCPD) in Wichita, KS, in mid-May. In his prepared paper, Solon outlined the research data and sketched several options for CRCPD members, who traditionally have focused on ionizing radiation. According to another participant, Ken Barat of the Arizona Radiation Regulatory Agency in Phoenix, there was agreement among participants at the meeting's NIER workshop that, "State radiation programs need to start dealing with [NIER] health issues." In a telephone interview, Barat explained that NIER is now being handled by various agencies in different states. "If we don't get involved, we're going to get passed by," he said.

LITIGATION

Waterbed Injury...A Tennessee teenage girl and her parents claim that "chronic exposure to electrical voltage she received

from a waterbed heater" caused her serious harm. In a suit filed on October 1, 1990, Kristen, James and Phyllis Pope charge that Kristen "suffered from and continues to suffer serious health problems," including joint and muscle soreness, discoloration of the legs, circulation problems and headaches. For an extended period, she could not walk without assistance. The Popes' attorney, David Smith of Kinnard & Smith in Nashville, said in a telephone interview that Kristen showed "dramatic improvement" after she stopped using the waterbed. Electrical engineers hired by the Popes measured 95-120 V on the waterbed, which they concluded was caused by the inverted insertion of the power plug into a wall socket, resulting in "improper polarization." The suit charges that the waterbed heater's manufacturer, Hakuto Co. Ltd. of Japan, and its subsidiary, Shigma, Inc., of Elk Grove Village, IL, should have provided polarized plugs or should have provided a written warning explaining proper insertion of the plug. The Popes are asking $1.25 million in damages. The trial is scheduled to begin in November.

MEETINGS

EBEA's First Congress... The European Bioelectromagnetics Association (EBEA) will hold its first congress January 23-25, 1992, in Brussels, Belgium. Abstracts are due by October 31, 1991. In addition to platform and poster presentations, roundtable discussions on specific topics are planned. Contact: Dr. M. Hinsenkamp, Hôpital Erasme, Service d'Orthopédie–Traumatologie, Route de Lennik, 808, B 1070 Brussels, Belgium, (32+2) 526-3640.

MM Waves in Moscow... An *International Scientific Meeting on Millimeter Waves of Non-Thermal Intensity in Medicine* will be held September 24-27 in Moscow, U.S.S.R. According to the announcement, Soviet researchers will present the results of 20 years of experience in theoretical and experimental research on non-thermal effects of high frequency radiation "on living systems of different level[s] of complexity." For more information, contact the meeting's organizing committee at: Marx Avenue 18, GSP-3, Moscow 103907, U.S.S.R. (7+095) 2033266.

Guy Festchrift... After 35 years at the University of Washington, Seattle, Dr. Bill Guy has retired, and a one-day symposium, sponsored by the USAF, will be held in his honor at the university on October 26. Guy is best known for his work on RF dosimetry, bioeffects and standards. Contact: Dorothy Pratt, Bioelectromagnetics Research Lab, RJ-30, University of Washington, Seattle, WA 98195, (206) 543-1071.

PEOPLE

Dr. **Om Gandhi** of the University of Utah, Salt Lake City, will be the new president of the Bioelectromagnetics Society. He will take over from FDA's Dr. **Mays Swicord** next year....Dr. **Allan Frey** has replaced Dr. **Andrew Marino** as president of the International Society of Bioelectricity. Marino also recently resigned as the editor of the society's journal (see *MWN*, M/J91). Frey reports that the society may change its name....**Greg Rauch** is leaving EPRI's electrical systems division to join **Bill Feero** at Electric Research and Management. Rauch will open a west coast office for the firm in Santa Cruz, CA....Drs. **Maria** and **Stan Stuchly** are moving to the University of Victoria's department of electrical and computer engineering in British Columbia, Canada. Stan has left the University of Ottawa and has taken up residence in Victoria as the department head. Maria will stay at Health and Welfare Canada until the end of the year before joining him....There has been a split at Environmental Research Information (ERI), the New York City consulting firm that has worked on EMFs for a number of utilities. **William Bailey** has set up Bailey Research Associates with former ERI staffers Drs. **Antonio Sastre, Deborah Weil** and **Linda Erdreich**; they will concentrate on EMF issues. Dr. **Jonathan Charry** said that ERI will continue to work on risk communication for corporate clients, but not on EMFs....Dr. **Russell Carpenter**, 89, who studied the effects of microwaves on the eye, died on July 28 in Williamstown, MA.

RADAR

Radar & Road Safety...A radar complex on the Yorkshire moors in the U.K. could cause traffic accidents on a nearby highway, according to a report by Tim Williams of ELMAC Services, a consulting firm. Williams measured electric fields of up to 30 V/m on a highway at Fylingdales in northern England, close to a Royal Air Force ballistic missile early warning system radar, which operates at a frequency of approximately 400 MHz. Williams notes that the peak fields, which are difficult to measure, may be two or three times higher than the average levels. These peak fields could interfere with electronically controlled vehicular safety systems, such as anti-lock brakes, which are designed to be immune to fields of up to 50 V/m. Measurements taken on footpaths near the complex also recorded fields of 30 V/m, which, though well below NRPB and IRPA safety standards, may expose hikers to "potentially hazardous levels" of RF radiation. The report, issued on June 17, was commissioned by Nuclear Free Local Authorities (NFLA), a Manchester-based coalition that monitors military activity. NFLA warns that areas presently not within the radar's 120° coverage may face a tenfold increase in exposure when a 360° phased array radar begins operation at the site in mid-1992. The group plans further measurements at that time. For a copy of *RAF Fylingdales EMR Survey*, contact: David Bamber, Nuclear Policy and Information Unit, Town Hall, Manchester M60 2LA, U.K., (44+061) 234 3244.

More on Police Radar...FDA's Center for Devices and Radiological Health (CDRH) has recommended that "users of police radar should not place the front surface of the radar unit (the antenna) within 15 cm (6 inches) of any part of the body, while the unit is transmitting." In a June 20 letter to Dr. James Lin, chairman of the IEEE's Committee on Man and Radiation (COMAR), Dr. Alan Anderson, director of CDRH's Office of Science and Technology, also advised that, "The FDA knows of no convincing evidence of a risk of cancer or other hazards from exposure to the level and type of microwave radiation produced by police radar units." Anderson was responding to Lin's March 19 request for an advisory opinion because COMAR had received several inquiries from police departments. Meanwhile, John

Sweeney, an Agoura Hills, CA, attorney, has filed two new suits claiming that police officers Eric Bendure and Leo Hutchison of Petaluma, CA, developed cancer after using police radar units (see *MWN*, M/A91). Both suits were filed on April 18 in the U.S. District Court for California's Northern District. Sweeney had previously filed a police radar–cancer suit on March 12. More litigation may follow, because, according to Ohio Highway Patrol Trooper Gary Poynter, more than 50 police officers have reported developing cancer after using radar.

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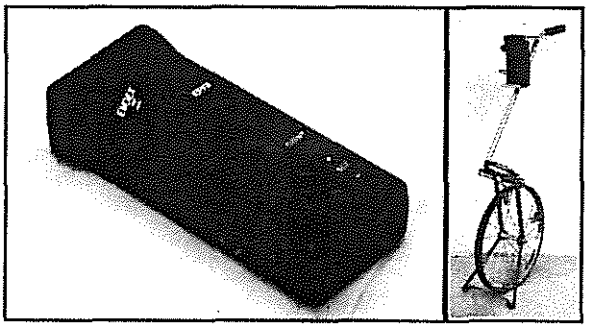
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EMF on the Airwaves... Perhaps it's coincidence, perhaps it's synchronicity, but one of the hottest pop bands in the world is called EMF. In mid-July, the British group's single, "Unbelievable," was at the top of the charts. We're not exactly sure what EMF stands for, but we hear that the "E" is for ecstasy—a psychedelic drug popular in certain locales—and that the "MF" stands for something we cannot print here.

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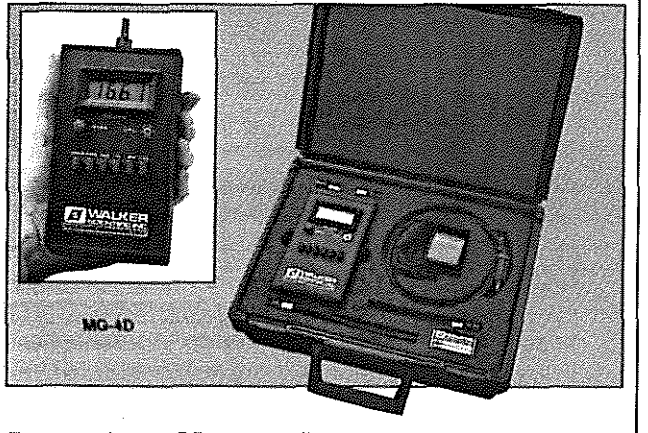
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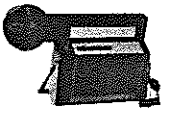
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Vol. XII No. 4 A Report on Non-Ionizing Radiation July/August 1992

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Making the Economic Case for EMF Bioeffects Research

For the last six months, Dr. Keith Florig has been saying that dealing with perceived electromagnetic field (EMF) health risks—prudently or otherwise—is now costing the U.S. over $1 billion a year, and perhaps much more (see *MWN*, N/D91 and M/A92). The cost of *not* doing research, he says, is far greater than that of doing the work that might show, as some critics argue, that there are no low-level EMF risks.

Florig, a fellow at Resources for the Future in Washington, has just published the details of his analysis in the July 24 issue of *Science*, one of the country's most influential policy forums.

On the basis of a rough cost–benefit analysis, he estimates that if the cancer risks are as "large as suggested by some epidemiological evidence," the U.S. could "justify spending" on the order of $10 billion a year on EMF mitigation. "This may not be much more than the highly uncertain estimates of the costs of our current ad hoc efforts—and, if applied entirely to the electric power system, would increase electricity costs by only several percent," Florig told *Microwave News*.

Billions of dollars may be being wasted, Florig allows, but this can only become known "through additional bioeffects research." He rejects as politically unrealistic the call of those who would prefer to "quell 'irrational'

(continued on p.13)

Judge Extends Time for Filing RF/MW Radiation Exposure Claims

A New York trial judge has ruled that claims arising from exposure to radiofrequency and microwave (RF/MW) radiation are not subject to the usual statute of limitations. The June 30 decision from Judge Edward Lehner gives people more time to file lawsuits after they have been injured, a policy similar to the one followed in asbestos and DES cases.

"This decision will not be lightly disregarded," said the plaintiff's lawyer, John Sweeney of John E. Sweeney & Associates in Agoura Hills, CA.

The product liability suit was brought by Thomas Ford, who worked as a U.S. Navy radar technician between 1965 and 1967. Ford believes that his military exposure to RF/MW radiation caused his non-Hodgkin's lymphoma. He filed a claim in 1990, which he said was two years after he began to suspect the radar. Ford holds the manufacturers of the radar equipment responsible for negligently causing his injuries (see *MWN*, N/D90).

(continued on p.13)

« Power Line Talk »

A panel set up by the Committee on Interagency Radiation Research and Policy Coordination (**CIRRPC**) has completed its review of EMF health risks and is set to release its report. The panel argues strongly that there is no compelling evidence of adverse health effects from power line or VDT EMFs, *Microwave News* has learned, and it opposes any major expansion of EMF research funding. Commissioned in the fall of 1990 at the request of the Department of Labor in reaction to the series of articles in *The New Yorker*, the review was put in the hands of the Oak Ridge Associated Universities (**ORAU**) in mid-1991, after a false start (see *MWN*, N/D90, J/A91 and S/O91). The 450-page CIRRPC response has not yet been seen outside of ORAU, said Diane Flack, a technical adviser in ORAU's Washington office. It will be made available to the public and the federal agency representatives that make up CIRRPC at the same time, she told *Microwave News*, in an effort to assure the independence of the expert panel that conducted the review. Top administration officials were briefed on the findings on June 15—and were given explicit warnings that the briefing was confidential. The White House science adviser, Dr. **Allan Bromley**, did not attend. Among other key points reportedly made by the panel: epidemiological links to childhood leukemia are inconclusive; there is no strong evidence of carcinogenicity; there is no compelling evidence of developmental or teratogenic effects; and neurobehavioral effects are generally temporary and not severe.

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Dr. **Gerri Lee**'s epidemiological study of miscarriage risks among users of **electric blankets** has many people talking. Lee, who is with the California Department of Health in Berkeley, presented some preliminary results at a by-invitation-only workshop sponsored by **EPRI** and the **DOE** in early July—she reported an up-to-fivefold increased risk among women who use electric blankets. In an interview with *Microwave News*, Lee said that she would prefer not to discuss her results because "they are based on crude preliminary analyses of retrospective, incomplete data." Her study is much anticipated because it is the first prospective study of its kind, but Lee pointed out that she has only looked at the retrospective part of her data. "The final results could easily change," she cautioned. If Lee does conclude that electric blanket users suffered high rates of miscarriages, her study would be the fifth to indicate that EMFs can affect pregnancy. Lee's final results are not expected until next year.

«« »»

At the time the House of Representatives included a major EMF research initiative in the **national energy strategy bill** it passed earlier this year (see *MWN*, M/J92), many on Capitol Hill expected Congress to approve the energy legislation quickly. But it now seems that time is running out to reconcile differences between the House and Senate bills, as legislators are anxious to get on the campaign trail. The Senate version, which does not contain any EMF provisions, was approved on July 30, after a battle over coal miners' health benefits threatened to kill it. As we go to press, the legislation is in the hands of a House–Senate conference committee, only some of whose members have been named. The committee is expected to meet once in August and reconvene after Labor Day, according to a House aide. If the energy legislation fails, it will be a whole new ball game for congressional EMF research funding in 1993. Rep. **James Scheuer** (D-NY), chairman of the subcommittee that launched this year's EMF bill, will retire at the end of this session. Rep. **George Brown** (D-CA), the influential chairman of the House Science, Space and Technology Committee, who has shown a continuing interest in a national EMF program (see *MWN*, J/F92), is facing a tough reelection challenge from Republican Dick Rutan. Brown must run in a redrawn district—one that now favors a Republican, according to *Roll Call* (July 13), a Capitol Hill newspaper which lists Brown as one of the ten most vulnerable House Democrats.

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The prospects of the National EMF Research Program (**NERP**) Steering Committee that is being led by **John Coughlin** of the Wisconsin PSC have risen and fallen with the energy bill. If the EMF program contained in the energy legislation is enacted, Coughlin's committee will have little or no role, according to many observers. But if the energy bill fails, "We really will be the only game in town," Coughlin told *Microwave News*. Key utility groups agree. Rick Loughery of the Edison Electric Institute (**EEI**) said that EEI supports a legislated research program but added that if the EMF program dies in Congress, then "the NERP is probably where we're going to turn." Similarly, Anne Strauss of the New York Power Authority (**NYPA**) told us that, "We cannot afford to wait another two years" to start a major research effort. According to Loughery, "The next meeting for the NERP is going to be critical."...At the steering committee's July 14-15 meeting in Alexandria, VA, NIOSH's Dr. **Lawrence Fine** became a member. And a week later, Coughlin announced that DOE's **Marvin Gunn** would also join the committee, bringing to three—with EPA's **David Kleffman**—the number of federal government representatives. The committee also opened the door to more direct industry involvement by deciding to allow utility company officials to join as nonvoting members—a departure from a year-old practice meant to maintain distance between the NERP and industry. So long as the utility representatives are only observers, their involvement "doesn't compromise them or us," said Coughlin. The subject of credibility was on the agenda at the July meeting as the committee discussed a draft policy stating that the NERP "must identify and avoid situations that may result from real, perceived or potential conflicts of interest." The committee hopes

Commentary

Fear and Cowardice at EPA

Little has been resolved in the more than two years since the Environmental Protection Agency (EPA) stunned the country with its report, which labeled EMFs "probable" or "possible" carcinogens. While some reviews have cast doubt on the strength of EPA's conclusions, recent studies—notably, Peters on childhood cancer and McLean and Stuchly on EMF–chemical cancer copromotion in animals—have made the link all the more convincing.

Incredibly, EPA has failed to sponsor a single study of any kind to explore the EMF–cancer connection since it issued the report. The agency is pretending that the report does not exist and that it never sounded the alarm. Staffers at EPA's Office of Research and Development, which is headed by Dr. Erich Bretthauer, have even refused to spend the meager $1.9 million allocated by Congress for EMF research in 1992. With only a few weeks left in the fiscal year, this money will probably have to be returned to the treasury.

Last year, rather than fund any original work, Bretthauer gave most of his EMF money to the Health Effects Institute (HEI) in Cambridge, MA so that the institute could teach itself about EMFs in preparation for running a National EMF Research Program (NERP). That money was wasted. First, no one could understand why EPA was not using its own in-house experts. Then, Bretthauer and his aides, Dr. Ken Sexton and Dr. William Farland, got egg on their faces after word got around that HEI had a credibility problem over its work on asbestos. After all, the whole point of a NERP was that it be free from real or perceived biases. Otherwise, it would have been easier to let the electric utility industry handle the EMF question.

EPA's performance is no different than crying "Fire!" in a crowded theater. Having raised the alarm over EMFs, the agency has an obligation to try to allay public concerns or to adopt policies to control health risks. All sides agree that more research is needed—Dr. Keith Florig has now shown that EMF research also makes good economic sense (see p.1)—so why does EPA refuse to spend its few available dollars at a time when EMF scientists are begging for money to keep their labs open?

The answer lies at the highest levels of the Bush Administration. Dr. Allan Bromley, the President's science adviser, and the U.S. Air Force want to stifle the EMF issue—and, in many ways, they are succeeding. The about-to-be-released CIRRPC report promises to show their hand by taking an absurdly dismissive view of the possibility of EMF health risks (see item at left).

After having been called onto the White House carpet a few times, Bretthauer and his crew got the message and they now turn a deaf ear whenever the subject is raised. Things are so bad that Bretthauer won't even let the Office of Radiation Programs, in another part of EPA, issue a booklet to answer the public's questions about EMFs. As one EPA staffer told us, "Our managers are absolutely terrified about this issue."

There are rumors that EPA Administrator William Reilly made a deal with Bromley: Bromley would support EPA on greenhouse gases if Reilly ignored EMFs. If true, Bush's performance at the Rio environmental summit would indicate that Reilly sold out EMFs for nothing.

It may be too late, but EPA could salvage the $1.9 million by giving the money to the NERP Steering Committee, chaired by Wisconsin PSC Commissioner John Coughlin. This small amount of money would be a windfall for the committee, which is fighting for its life after more than a year of trying to get a research program off the ground.

If Bretthauer refuses to do EMF research, at least he could give the money to a group that *is* committed to doing it. The public deserves answers and it's time someone had the courage to give them some.

to insulate itself from potential conflicts by giving decision-making authority to a newly created board of directors and limiting the steering committee to an advisory role. Some current committee members will serve on the board. The committee is planning its fall meeting to coincide with either the EPRI science and communication seminar in San Francisco, October 13-16 or the annual DOE Contractors' Review in San Diego, November 9-12.

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On June 22, the **Connecticut** legislature overrode a veto by Governor Lowell Weicker, assuring that the state's EMF Interagency Task Force will continue to report to the General Assembly. "Even if the task force had lost its legislative mandate, we still would have followed the issue," Dr. **Peter Galbraith** of the Department of Health Services (DHS), cochair of the task force, told *Microwave News*. "But this way the DHS won't appear to have closed the book on EMFs." The new law—Public Act 92-169—essentially continues work begun under an earlier measure that Weicker signed in June of 1991 (see *MWN*, M/J91, J/A91 and M/A92). On July 28-30, the DHS and the task force sponsored a meeting, *Electromagnetic Fields: How Do We Deal with the Issues?* at which Drs. **Michael Bracken, David Carpenter** and **Jan Stolwijk** spoke. All three are members of the ad hoc committee that wrote the **Connecticut Academy of Science and Engineering**'s recent report, which found that it would be "inappropriate" for public authorities to recommend a policy of prudent avoidance (see *MWN*, M/J92). According to Don Michak's account of the meeting in the *Journal Inquirer* (July 29), Carpenter "threatened to quit the panel" because the report downplayed the EMF–cancer link. This fall, the task force plans to issue a study of prudent avoidance, and in January, Connecticut Health Commissioner Susan Addiss will advise the legislature on recent research on EMFs and health effects.

The Economics of Mitigation

Magnetic fields from power lines can be reduced substantially—depending on how much one wants to spend, according to a report commissioned by the Rhode Island EMF task force. The $81,500 study, financed by Rhode Island utilities, looks at the costs associated with different magnetic field-reducing techniques.

Burying power lines—the most effective option—costs nearly four times as much as traditional overhead designs, according to the report prepared by Commonwealth Associates of Jackson, MI. While a 345 kV H-frame configuration costs $390 per mile to build, putting the same line underground would cost $1,450 per mile. The cost and effectiveness of the other alternatives fall between those of the traditional and the underground designs.

"The task force will probably propose that the state Energy Facility Siting Board assume jurisdiction over the siting and construction of high voltage power lines, including those of 345 kV or below," Scott Wolf, chairman of the Governor's EMF Task Force, told *Microwave News*. He noted that the board now only regulates lines over 345 kV, of which there are "really none" in the state. The task force will issue its recommendations to the governor by the first week in August, he said.

The study, released to the public on June 24, features more than 90 pages of charts and diagrams. It focuses on mitigation techniques that "take advantage of the natural canceling effect of the three-phase circuit." Analysis is limited to 115 and 345 kV transmission lines—those planned for Rhode Island. Similar mitigation reports have been commissioned in Florida, New York and Washington State (see *MWN*, J/F92).

Florida's report will be completed by October, according to Ken Klein, of Energetics Inc., who is based in Washington and who manages the project (see *MWN*, M/A89 and M/J90). The study, which he said will cost less than $300,000, is looking at alternative designs for 230 kV and 500 kV lines.

In New York, two mitigation studies are under way and should also be completed by October, according to John Wilson of Con Edison, who is a member of the Empire State Electric Energy Research Corp.'s EMF Task Force (see *MWN*, M/J90).

Excerpts from the Rhode Island report, *Cost Effectiveness Analysis: Mitigation of Electromagnetic Fields*, follow:

- For 345 kV overhead transmission, magnetic fields at the edge of [the] right-of-way can be reduced by 45% (relative to existing H-frame structures) by designing support structures to result in a compact delta configuration of the phase conductors...the incremental increase in construction cost for this design is 21% and in life-cycle cost, 14%.
- Edge of right-of-way magnetic fields can be reduced by 75% over existing 345 kV H-frame designs by using a six-wire configuration. ...The incremental increase in construction cost for this design is 41%, and in life-cycle cost it is 27%.
- Underground 345 kV transmission provides the greatest reduction in magnetic fields. [The field] is estimated to be 1.7 mG [directly above a buried pipe] and 0.12 mG 25 feet from the pipe for 600 amp loading. The estimated construction cost...is 372% more than for existing overhead design and 266% more on the basis of life-cycle cost.
- For 115 kV overhead transmission, there is more opportunity for the designer to compact the phase spacing than at 345 kV. By decreasing the phase spacing and arranging the phases in a delta arrangement, the edge of right-of-way magnetic fields can be reduced by 57%....The construction cost and life-cycle cost of the compact design are nearly the same as for existing 115 kV H-Frame designs.

A limited number of copies of the Rhode Island report, for which there might be a charge, are available from: Scott Wolf, Chairman of the Governor's EMF Task Force, Statehouse, Room 111, Providence, RI 02903, (401) 277-2850. For more on six-wire configurations, see *MWN*, J/F92.

DOE Research Plan Draws Weak Public Response

The Department of Energy (DOE) has tried to solicit comments on its EMF research agenda but has been frustrated by a lack of involvement by grass-roots citizens groups.

Only a handful of power line critics spoke at two meetings—in Denver on June 29 and in Philadelphia on July 9—that were held to learn the public's opinion of DOE's national EMF program. Most who testified were from the utility industry, government or various research organizations—all of which have participated throughout the planning process that the DOE began last November (see *MWN*, N/D91, J/F92, M/A92 and M/J92).

DOE officials have said that the final research plan, which is due in September, must reflect a consensus of all interested parties. The agency has not scheduled any more public meetings but is accepting written comments through August 7.

The DOE's EMF staff was disappointed by the weak public turnout, Robert Brewer, director of the department's utility systems division, told *Microwave News*. He said that the DOE had expected the upswing in media coverage of EMFs and the growing number of citizens groups across the country to generate much greater involvement.

The DOE had picked Denver and Philadelphia for the hearings because both are focal points in the debate over power line EMFs. Two of the major epidemiological studies of EMF exposure and childhood cancer were carried out in Denver (see *MWN*, N/D86). And a well-organized citizens group is opposing a 230 kV transmission line built by Philadelphia Electric Co. (PECO) in suburban Philadelphia (see *MWN*, M/J91).

At the Denver meeting, only three people spoke—none on behalf of citizens groups. And, of the three, one came forward only after being encouraged to do so by DOE staff during the course of the meeting, according to Brewer. In Philadelphia, 12 people spoke; four were EMF activists, including Louise Young, the author of *Power over People*, first published in 1973 and recently reissued by Oxford University Press.

The group fighting the PECO line, Parents Against an Unsafe Environment (PAUSE), did not show up in Philadelphia. Although the DOE announced the meetings in the *Federal Register* on June 2, PAUSE's Dorothy English told *Microwave News* that she did not hear about it until late June. "We should have had more time," English said.

Other citizens groups made similar complaints. For instance,

Harry Kochenderfer of the York County (PA) Citizens' Action Group testified that he could not comment on DOE's *Draft Strategic Overview* because he had only seen it for the first time that day. His group and several others are opposing a proposed 500 kV line between Pittsburgh and Harrisburg (see p.6).

Michael Reed of DOE's Morgantown, WV Energy Technology Center criticized his own department for not informing its field offices about the ongoing EMF planning process. In Philadelphia, he said that he had learned about the development of DOE's research agenda just a few days before the meeting. "EMF is very important to us," Reed said.

Legal Notebook

$2.5 Million Power Line Relocation Delayed

On July 8, the Illinois Commerce Commission (ICC) agreed to reconsider an earlier decision which would have forced Commonwealth Edison Co. to relocate a 138 kV power line. Pending the outcome of its review, the commission granted the utility a stay—delaying the move, which the company estimates would cost $2.5 million.

On May 28, the ICC ordered Chicago-based Commonwealth Edison to move the power line within three years. It found that the utility violated the state Public Utilities Act when it failed to seek permission for an upgrade from 34 kV. The upgrade was completed in 1987.

The ICC discovered the violation after Nick Lazazzera of Westchester, a suburb of Chicago, complained in 1990 that the transmission line was too close to his house and that it threatened his health and the value of his property. The commission didn't rule on either of these claims, but did order the utility to try to get rid of Lazazzera's television interference, about which he had also complained.

A spokesman for Commonwealth Edison, John Hogan, who called ICC's decision to rehear the case "very good news," said that the power line in question is an emergency standby line that is only "minimally energized." He said that Commonwealth Edison never had to ask permission to upgrade a power line in the past, and that ICC's May order was "arbitrary and unnecessarily costly."

The commission said that it granted the rehearing to determine whether Commonwealth Edison needed to apply for a permit, according to ICC spokesman David Farrell. A hearing date has not been set.

Judge Excludes Testimony In EMF Case

An Alabama judge has excluded EMF testimony from a lawsuit, arguing that there is not enough scientific evidence that EMFs are a health threat.

Alabama Power Co. had asked the judge to take this position in its case against Western Pocahontas Properties Ltd. Partnership. In 1988, the Birmingham-based utility condemned a strip of land that runs through property owned by Western Pocahontas in Shelby County, outside of Birmingham, to build a 30-mile, 230 kV power line. The two sides disagreed over how much money the utility should pay for the condemnation, which Western Pocahontas claimed would devalue adjacent land. "Power lines devalue property," said Alan Baker of Balch & Bingham in Birmingham, which is representing Alabama Power, "but not as much as they say."

In his May 1 decision, Circuit Court Judge Al Crowson ruled that the testimony of Dr. Andrew Marino of the Louisiana State University Medical Center in Shreveport should not be admitted because of the speculative nature of EMF bioeffects—or, in legal terms, because it did not meet the Frye rule.

The Frye rule grew out of the 1923 case, *Frye v. U.S.*, in which the court considered the "admissibility of evidence derived from a crude precursor of the polygraph," according to *Weinstein's Evidence*, a leading legal treatise. The court stated that the subject of testimony must be "sufficiently established to have gained general acceptance in the particular field [to] which it belongs." The Federal Rules of Evidence—which were adopted in 1973 and govern proceedings in U.S. courts—have since overridden *Frye*, but some judges continue to use the rule in their decisions. In two previous cases in Alabama, for example, judges refused to allow scientific testimony on EMFs for this reason.

At the same time, the U.S. Third Circuit Court has rejected the Frye rule, calling it "vague and conservative, and easily manipulated by the courts, usually to reject novel scientific evidence."

"I disagree with the judge's decision," said Jeff Grantham of the Birmingham firm of Maynard, Cooper, Frierson & Gale,

DOE Issues Overview of EMF Research Plan

The DOE has released its *Draft Strategic Overview: National EMF Research and Communication Program*, a summary of the agency's work on a coordinated EMF plan. The 21-page document describes the need for national research and lists the goals of the program (see *MWN*, N/D91). The DOE designed the overview to brief the general public and to provide a basis for comments and criticisms from advocacy groups.

The overview lists three priorities:

- Development of a research plan that takes into account all sides of the EMF issue;
- Involvement by other federal and state agencies and trade associations, as well as representatives from other countries; and
- Establishment of safeguards to ensure that research is of the highest scientific quality and credibility and to avoid "real or perceived" conflicts of interest.

Comments will be considered by the DOE officials preparing the final national plan, which is due in September. The overview was published in the June 2 *Federal Register* (pp.23,206-23,213); to order a copy of the *Draft Strategic Overview*, contact: Advanced Industrial Concepts Division, CE-232, 5E-066, DOE, 1000 Independence Ave., SW, Washington, DC 20585, (202) 586-5377.

State EMF Actions

Colorado...A group of scientists has found no link between EMFs and human health effects. Yet the researchers are quick to point out that, "It is equally clear that the book is not closed. Several questions remain unanswered...." The Universities Consortium on EMFs—five scientists from three Colorado universities—screened more than 11,000 articles to find those which were most methodologically sound. Although several of the human studies showed a correlation between EMF exposure and disease, "careful analysis...revealed possible bias in selection of controls." *Investigations in Power Line Frequency EMF and Its Risks to Health: A Review of the Scientific Literature*, released in June, was prepared with a $160,000 grant from the Public Service Co. of Colorado. "The report was our first project," said Edward Dauer, professor of law at the University of Denver and chairman of the Governance Committee that oversees the consortium, which was formed in January 1991. "We plan to be research managers—in the business of helping utilities or public agencies administer research projects." To order a copy of the report, contact: Michelle Reynolds, UCHSC, 4200 East 9th Ave., B165, Denver, CO 80262, (303) 270-7545. Elsewhere in Colorado, the Supreme Court—which had reversed a ruling denying Public Service's request to upgrade transmission lines—has granted Douglas County's request for a new hearing, sending the case back to the district court (see *MWN*, N/D89, M/A91 and M/J92). A date has not been set.

Florida...On June 23, Hillsborough County mounted its latest attack on the Department of Environmental Regulation (DER), when it proposed a 3 mG limit at the edge of rights-of-way for power lines of at least 230 kV. "We wanted to offer a first step in reducing exposure to EMFs," Michael Skelton of de la Parte & Gilbert, the Tampa law firm representing the county, told *Microwave News*. Skelton also said the county chose to take action after the DER failed to reconsider state standards (see *MWN*, J/F92). "We shouldn't change the standard until we get more science," said DER's Buck Oven. "I don't know if 3 mG is good enough." The issue will be discussed at the Environmental Regulatory Commission's October meeting.

Illinois...Utilities should take "prudent measures" to reduce EMFs, write two state agencies in a March report to the legislature. The Department of Public Health (DPH) and the state Environmental Protection Agency stress that setting state standards would be premature—given that EMFs are not a proven health threat—yet note that uncertain scientific evidence "indicates cause for concern." The report recommends that utilities reduce EMFs by providing larger rights-of-way, avoiding population centers and using mitigation techniques in future transmission lines. For a free copy of the 70-page report, *Possible Health Effects of Extremely Low Frequency Electric and Magnetic Field Exposure: A Review*, contact: Louise Boyd, DPH, Division of Environmental Health, 525 West Jefferson, Springfield, IL 62761, (217) 782-5830.

Pennsylvania...A battle is shaping up as citizens are opposing plans for a 268-mile, 500 kV transmission line between Pittsburgh and Harrisburg. PUC Commissioner Wendell Holland has called the dispute "one of the biggest cases I've ever seen," noting that the two sides have submitted at least 9,000 statements and other documents. Three subsidiaries of General Public Utilities—Pennsylvania Electric Co. in Johnstown, Metropolitan Edison Co. in Reading and Jersey Central Power & Light Co. in Morristown, NJ—are working on the project with the Duquesne Light Co. of Pittsburgh. The PUC is considering the utilities' proposal but has not set a date to begin public hearings. Harry Kochenderfer of the York County Citizens' Action Group in Franklintown is leading the opposition, along with two other citizens groups. Meanwhile, HB 2273, drafted by Rep. Patricia Carone in response to the proposed power line, continues to await a hearing in the Conservation Committee (see *MWN*, M/A92).

Washington...An EMF task force in Spokane is proposing that utilities be required to publish annually a six-year plan identifying potential routes for future power lines and substations. The group said the requirement would be a good way to keep the public informed. In its June report, the task force also recommends that the city not adopt safety standards because "not enough is known about the health risks associated with EMF...." For a copy of the *Electric/Magnetic Field Task Force Report*, contact: Irving Reed, Manager, Engineering Services, City of Spokane, 808 West Spokane Falls Blvd., Spokane, WA 99201, (509) 625-6270.

which is representing Western Pocahontas. Grantham added that he would have liked Marino to testify, but that "he's just one part of our case." Western Pocahontas, based in Huntington, WV, is focusing on the effects of power lines on property values, not on health. A trial date has been set for September in the Shelby County Circuit Court.

Georgia Utility Agrees To Release EMF Documents

On July 10, the Oglethorpe Power Co. withdrew its request for confidentiality in an EMF personal injury case, assuring public access to relevant documents.

Nancy Jordan and her family filed a lawsuit against Georgia Power Co. and Oglethorpe in 1991, claiming that power line EMFs caused her non-Hodgkin's lymphoma (see *MWN*, S/O91 and M/J92). The case is pending in state court.

On May 8, Trial Lawyers for Public Justice (TLPJ), a public-interest legal group, filed a motion to block the protective order requested by Oglethorpe, which sought to keep certain documents from the public file. But the utility later agreed to release the information and TLPJ withdrew its motion. Oglethorpe is based in Tucker, GA.

"This is an important victory not only for the injured parties, but also for the public's right to know about the dangers of EMF," said TLPJ Foundation President Anthony Cunningham of Cunningham, Wagner, Vaughan & McLaughlin in Tampa, FL.

In withdrawing the request, attorneys for Oglethorpe wrote that most of the information the utility had wanted to keep confidential "did not relate to EMFs." James Orr of the Atlanta firm of Paul, Hastings, Janofsky & Walker, who is representing the utility, declined to comment further.

Georgia Power "took no position" on Oglethorpe's action, according to Robert Pennington of the Atlanta firm of Troutman & Sanders, which is representing Georgia Power in the case.

Scenes from the World Congress

The *1st World Congress for Electricity and Magnetism in Biology and Medicine*, held at Disneyworld in Orlando, FL, June 14-19, attracted some 733 participants from 30 countries. Here are some snapshots from the meeting.

Army v. Air Force on HPM Research

One of the most surprising—and tense—moments of the congress took place in a back room at a sparsely attended session on high-power microwaves (HPM). Dr. Edward Elson of the Walter Reed Army Institute of Research (WRAIR) in Washington was describing experiments showing that animals became confused and disoriented after exposure to various types of short, high-peak, pulsed HPMs with average power levels below those specified as safe by the IEEE standard (C95.1-1991).

The Department of Defense (DOD) supports the standard, so it was surprising to hear Elson, an Army colonel, cast doubt about its adequacy, but then he went even further. The safety question may be resolved by politics, not by science, he said, taking aim at Pentagon plans to consolidate all military nonionizing radiation research under Air Force control at Brooks Air Force Base in San Antonio, TX.

Elson's concern over what would happen to his research program if it were moved to Brooks is shared by some at the Naval Aerospace Medical Research Lab in Pensacola, FL.

Senior DOD officials favor the consolidation as a way of cutting costs, but those who actually do the research doubt the Air Force's scientific credibility. They believe that the Air Force puts a higher priority on promoting electronic gadgetry than on protecting health and safety.

Elson's message was clear: if the Army and Navy go to Brooks, the HPM work will stop. Spotting James Merritt, a longtime member of the Brooks team, in the audience, Elson challenged him to respond. A somewhat reluctant Merritt came to the microphone to say the work would indeed continue.

Understanding the effects of HPMs is important because the DOD plans to use microwaves—both defensively and offensively. For instance, in the battlefields of tomorrow, impulse radars, which emit ultrawide-band HPMs, will detect so-called stealth aircraft such as the B-2 bomber, and HPMs will zap the enemy's electronics. Elson's experiments suggest that pilots flying through HPM environments may become confused and unable to make the quick decisions that keep them aloft and alive.

Leakage Through the Blood–Brain Barrier

The history of efforts to investigate the effects of microwave radiation on the integrity of the blood–brain barrier (BBB) is a clear example of how politics can sidetrack an important line of research (see *MWN*, S/O86). In 1977, two Army scientists reported that pulsed 1.3 GHz radiation could cause BBB leakage at 30 $\mu W/cm^2$, but this finding has never been properly pursued.

Although scientists in the U.S. have essentially been barred from this kind of BBB study, those in other countries have dared to go forward. In Orlando, two Swedish researchers said they could increase the permeability of the BBB with extremely low levels of 915 MHz radiation.

Drs. Leif Salford and Bertil Persson of Lund University in Lund announced highly significant increases in leakage through the BBBs of rats at specific absorption rates (SARs) as low as 0.01-0.1 W/Kg. (Most standards assume that there are no health effects below 4 W/Kg.) They were surprised not to find a dose–response curve: they observed about the same leakage from 0.01 to 3 W/Kg (it increased above 3 W/Kg).

Some of those who heard their presentation suspected that the rats had experienced a thermal reaction. Not so, Persson told *Microwave News*, explaining that they had checked this possibility by measuring rectal temperatures immediately after exposure; they had used a fan to dissipate excess heat, he said.

Salford, a neurosurgeon, explained that he had become interested in microwaves as a way of treating brain tumors because the conventional therapies are woefully unsuccessful. If leakage through the BBB could be controlled, he reasons, perhaps drugs could one day be delivered directly to the tumors.

"The system we are using is very sensitive and we invite others to learn our techniques," Salford said in an interview. In the meantime, he and Persson said, their work will continue.

Protection from Melatonin Blocked by EMFs

Interest in the possible influence of EMFs on the pineal gland and the hormone melatonin continues to grow. Indeed, shortly after the congress, a number of those who were in Orlando flew to Palo Alto, CA for a two-day workshop on *EMFs and Melatonin*, jointly sponsored by the Electric Power Research Institute (EPRI) and the Department of Energy (see p.2).

At the congress, Margrit Wiesendanger, who works with Dr. Robert Liburdy at the Lawrence Berkeley Lab in Berkeley, CA, announced that extremely low frequency (ELF) magnetic fields can block melatonin's ability to control the growth of human breast cancer cells.

Wiesendanger first confirmed reports by Dr. David Blask, who has shown that melatonin can inhibit the growth of cancer cells *in vitro*. Using estrogen-positive MCF-7 human breast cancer cells, she then repeated the experiment in the presence of a 60 Hz field and found that melatonin's protective action was countered by the magnetic field.

The mechanism of interaction is unclear, Wiesendanger said. She offered two alternative explanations: the magnetic field may influence events at the membrane surface, possibly the way melatonin is bound to cancer cells; or the field may directly enhance the growth of the breast tumor cells.

"Our *in vitro* results suggest that direct cellular level interactions between ELF fields and melatonin and breast cancer cells are possible," Liburdy told *Microwave News*.

Future Directions for EMF Epi Studies

Some observers have a hard time making sense of the many EMF epidemiological studies that have appeared over the last few years. In her plenary address, Dr. Genevieve Matanoski of the Johns Hopkins University School of Hygiene and Public Health in Baltimore offered a guide for the perplexed by identifying some of the common threads of the research findings and outlining suggestions for future work.

Matanoski pointed out that for both childhood and adult studies the timing of the EMF exposure is emerging as a crucial variable. Exposures at an early age or repeated exposures over extended periods of time appear to enhance cancer risks, she said. As an example, she cited the male breast cancer study by Dr. Paul Demers and coworkers (see *MWN*, J/A90 and S/O91), which indicated a substantial increase in cancer among those workers who were first exposed before the age of 30 or first exposed 30 years prior to diagnosis. Indeed, Matanoski noted that her own study of telephone linemen indicated that the greatest risk of leukemia was among workers exposed at an early age (see *MWN*, J/A91).

Second, Matanoski stressed the importance of investigating the effects of combined exposures. "Instead of only thinking about confounders, we need to look at the combined risk of EMFs with both chemicals and ionizing radiation," she told *Microwave News* in an interview following her talk.

Depression and Power Lines

More than a decade has passed since Dr. Stephen Perry, an English general practitioner, published the first of a series of papers linking power line EMFs to depression and suicide. His work has been largely ignored—some people have been openly scornful—but one presentation at the congress breathed new life into Perry's ideas.

Drs. Charles Poole, an epidemiological consultant based in Cambridge, MA, and Robert Kavet of EPRI reported an association between depressive symptoms and proximity to the right-of-way (ROW) of a power line. The link was moderately strong and reasonably precise, and it did not appear to be biased by attitudes about power lines or environmental issues in general.

Overall, Poole and Kavet found that depression was twice as common among people who lived along a ROW or who could see a power line from their property—a statistically significant increase. They also found a weaker link between non-migraine headaches and proximity to power lines.

"Exposure assessment is the weakest part of the study, but it would be relatively easy to go back and get these data or to try to replicate the study," Poole told *Microwave News*. He pointed out that their study cost only one fourth that of a cancer epidemiological study, but he declined to reveal where their study was done or who paid for it.

But Perry's work is not yet in the mainstream. A second paper presented in Orlando contradicted Poole and Kavet's findings. Dr. Shari McMahan of the University of California, Irvine, failed to find more symptoms of depression among women living next to a high voltage power line than among women living a block away. Her paper was adapted from her recently completed doctoral thesis.

McMahan measured the magnetic fields at the front door of the women's homes: average fields were 4.86 mG among those adjacent to the line and 0.68 mG among the controls. McMahan controlled for potential biases by not telling the 152 participants that she was investigating EMFs—she also no doubt profited by the fact that most people are not aware that magnetic fields drop off with distance from a power line.

Epidemiology Roundup

Male Breast Cancer Among Workers Under 65

Dr. Dana Loomis has observed a doubling of breast cancer deaths among male electrical workers under the age of 65. This result is not statistically significant, but Loomis told *Microwave News* that, "It would certainly suggest that breast cancer among men *might* be caused by electrical exposures." Loomis, of the University of North Carolina (UNC), Chapel Hill, also noted a "substantial deficit" of breast cancer deaths among older electrical workers, however.

In a letter to *The Lancet* (339, pp.1482-1483, June 13, 1992), Loomis wrote, "The results are consistent with earlier reports of excess breast cancer among younger men, particularly those who have worked in electrical trades and telephone-related occupations."

He cautioned that his study had only a small number of cases and that it lacked information on EMF exposures and potential confounders.

In a survey of men from 24 states who died of breast cancer between 1985 and 1988, Loomis found four cases—the expected number—among electrical workers. However, three of the cases—one electric power worker, one electrical and electronics engineer-technician and one telephone worker—were younger than 65 years old at death. This finding is more than twice the expected rate.

This is the fourth study to link EMFs to male breast cancer. In 1989, Dr. Genevieve Matanoski and colleagues at the Johns Hopkins University School of Hygiene and Public Health in Baltimore reported an increased incidence of male breast cancer among young telephone company employees (see *MWN*, N/D 89 and M/A91). In 1990, Dr. Paul Demers and coworkers at the Fred Hutchinson Cancer Research Center in Seattle reported a sixfold increased risk among certain young electrical workers (see *MWN*, J/A90 and S/O91). Later that year, Drs. Tore Tynes

and Aage Andersen of the Cancer Registry of Norway in Oslo identified a significant doubling of risk among electrical transport workers (see *MWN*, J/F91).

Loomis and UNC's Dr. David Savitz reported an elevated rate of brain tumor deaths among electrical workers in 1989 (see *MWN*, N/D89).

Australian Study Finds CRT–Brain Tumor Risk

A new Australian study has found that women who worked at cathode ray tube (CRT) computer monitors developed brain tumors at close to five times the expected rate. This is the first study to investigate a link between video display terminal (VDT) use and cancer.

"We found a significantly increased risk for glioma [a type of primary brain tumor] associated with use of [CRTs] by females, although the number exposed was small," concluded a team led by Dr. Philip Ryan, a lecturer in public health at the University of Adelaide's Department of Community Medicine.

The team observed a nonsignificant *decreased* risk among men exposed to radiation in general. "I cannot explain the different estimates of risk between males and females," Ryan told *Microwave News*.

The researchers could not identify any other environmental hazard to explain their results. They cautioned, however, that their work shared the weaknesses of other brain tumor studies: a small number of cases, the potential for recall bias and an inadequate means of assessing cumulative exposures. In addition, their study was not based on any *a priori* hypotheses. "These factors may explain some of the present findings," they noted in their paper, which appeared in the *International Journal of Cancer (51*, pp.20-27, 1992).

More than a dozen studies have linked EMFs to brain tumors (see *MWN*, M/A90)—although none has specifically addressed VDTs.

While the researchers observed an increased risk for women exposed to sources of ionizing and non-ionizing radiation, the risk became more pronounced when limited to CRT use. There was a fourfold increase in risk for radiation exposure in general—and an almost fivefold increase for CRT work alone. Both findings are statistically significant. The risk was somewhat lower when the researchers excluded women who could not be interviewed in person.

There were six women with gliomas who worked at CRTs—three computer programmers, one computer operator, one office clerk and one road-transport supervisor.

The team investigated 170 cases of brain tumors diagnosed in adults aged 25-74 from 1987 to 1990 and 417 controls. Both

Epidemiology in Print

• In a series of letters in the May 1 *AJE (135*, pp.1069-1075) on the wire code–cancer link, two researchers took aim at the Savitz and the University of Southern California (USC) childhood cancer studies (see *MWN*, N/D86, and M/A91 and S/O91, respectively). Dr. Kenneth Mundt of the University of Massachusetts School of Public Health in Amherst argued that wire codes may be one of a number of interrelated surrogates for lower socioeconomic status, rather than an indicator of EMF exposure. He added that the controls may have been biased toward a higher socioeconomic level, thus skewing the results. Dr. David Savitz replied that, unlike those who dismiss the evidence on EMFs and cancer on "intuitive grounds," Mundt offered some valid criticism, which should be considered in the design of future studies. The USC team, led by Drs. Stephanie London and John Peters, responded that, "While Dr. Mundt raises interesting issues, we cannot conclude that his alternative explanation of our data is compelling." Raising some technical points, Dr. Michael Bracken of the Yale University School of Medicine in New Haven, CT expressed concern that the USC team's presentation of its data misled readers—particularly the media—about health effects. In response, the USC researchers pointed out that their paper was written "for the scientific literature, not the public media," and that very few of the reporters who contacted them had even read the abstract.

• A typographical error led to a misinterpretation in Dr. John Vena's study of electric blankets and female breast cancer (see *MWN*, S/O91). In a letter in the April 1 *AJE (135*, pp.834-835), Dr. Richard Stevens of the Battelle Pacific Northwest Labs in Richland, WA argued that if the pineal gland is the site of interaction, then electric blanket EMFs would not be significant since, according to calculations by Drs. Keith Florig and James Hoburg, they would be less than 1.0 mG at head level. Vena and Dr. Saxon Graham, both of SUNY, Buffalo, replied that their original paper relied on an abstract by Florig and Hoburg which contained a typographical error: it read 1.0-4.0 μT at head level instead of 1.0-4.0 mG. Vena and Graham conceded that although some evidence suggests that electric blanket use does not disrupt pineal function, they could not rule out other possible, more direct interactions.

• Two review papers on male breast cancer have recently appeared: a team led by Dr. David Thomas of the Fred Hutchinson Cancer Research Center in Seattle published "Breast Cancer in Men: Risk Factors with Hormonal Implications" in the *AJE (135*, pp.734-748, April 1, 1992); and the Italian–Swiss team of Drs. Carlo La Vecchia, Fabio Levi and Franca Lucchini published "Descriptive Epidemiology of Male Breast Cancer in Europe" in the *International Journal of Cancer (51*, pp.62-66, 1992)....In addition to breast and brain cancer, prostate cancer is also on the rise, according to the Centers for Disease Control in the June 12 *Morbidity and Mortality Weekly Report* (pp.401-404).

• Challenging prevailing opinions, two British scientists are each proposing that childhood leukemia is the result of viral infections. According to the June 19 *Science (256*, p.1633), Dr. Melvyn Greaves of the Leukaemia Research Fund Centre at London's Institute for Cancer Research suggests that exposures to common viruses may have compromised the immune systems of childhood leukemia sufferers. Dr. Leo Kinlen of Oxford University's Cancer Epidemiology Research Group lays the blame on as-yet-unidentified cancer-causing viruses.

cases and controls were from metropolitan Adelaide.

The study is one of ten on adult brain tumors being carried out in seven countries around the world. This international effort is being organized by the International Agency for Research on Cancer (IARC) in Lyon, France. The Adelaide study is the only one that has analyzed data on CRT exposure, Ryan said. He does not expect the complete results of all ten studies to be published before mid-1994, at the earliest.

No Birth Defects for Electric Blanket Users

Pregnant women who used electrically heated beds (EHBs) in their first trimester were at no increased risk of giving birth to infants with certain congenital defects, according to a new study.

"These results suggest that 60-cycle fields do not cause neural tube and oral defects," concluded a team led by Dr. Larry Dlugosz of the Department of Social and Preventive Medicine at the State University of New York (SUNY), Buffalo. The team included Dr. John Vena, also of SUNY, and Dr. Michael Bracken of the Yale University School of Medicine in New Haven, CT (see also p.9).

The researchers said that they selected neural tube and oral cleft defects because they are established before the second trimester, are obvious at birth and are influenced by environmental factors. There have been no reports of an excessive rate of neural tube or oral cleft defects in EMF–laboratory animal experiments, they noted in the May 1 *American Journal of Epidemiology (AJE, 135*, pp.1000-1011).

The researchers studied 1,070 women (535 cases and 535 controls) living in upstate New York who gave birth in 1983-1986. The women were asked about their use of EHBs for the period of one month before to three months after their estimated date of conception. EHB exposures were estimated to be approximately 3-5 mG.

Although the researchers called for additional study of EMFs and adverse pregnancy outcomes, they lamented that the advent of new "low field" EHBs (see *MWN*, M/J90) and the widespread publicity about potential EMF health effects "will make it difficult, if not impossible, to conduct an unbiased observational study of this type in the future."

Melanoma Linked to Fluorescent Lights

A new Canadian study has determined that men exposed at work to fluorescent lighting had a significantly elevated risk of developing melanoma, a type of skin cancer.

Dr. Stephen Walter and coworkers at McMaster University in Hamilton, Ontario also found that men exposed to fluorescent lighting at home had an increased cancer risk. There was no consistent risk increase among women, however.

"While the combined evidence is not sufficient for immediate alarm, we feel that fluorescent light should continue to be investigated," they concluded in the April 1 *AJE (135*, pp.749-762). "Because fluorescent light devices may generate a substantial portion of human exposure to ultraviolet B, they must be considered as a potential risk factor for melanoma."

For men who had cumulative occupational exposures of more than 20 years, the odds ratio (OR) was 1.77; for exposures of more than 30 years, the OR was 1.92. The dose–response relationship is statistically significant. The team investigated 583 cases (277 men and 306 women) diagnosed between 1984 and 1986 and 608 controls (283 men and 325 women). All were residents of southern Ontario.

In 1982, an Australian team reported a doubling of skin cancer risk among women and men exposed to fluorescent lighting at work (see *MWN*, S82).

Motion To Dismiss Police Radar Case Denied; Trial in November

The first trial in a police radar product liability case is scheduled to begin November 10. The path was cleared when, on July 23, U.S. District Judge Stanley Weigel denied a motion by the radar manufacturers to dismiss the lawsuit brought by Police Officer Eric Bendure, who has non-Hodgkin's lymphoma.

In their motion for summary judgment, Kustom Signals Inc. of Overland Park, KS and MPH Industries Inc. of Owensboro, KY had challenged the alleged link between police radar and cancer. They argued that there is no basis in the scientific literature to support claims of a health risk.

"The defendants contended that our case was based on 'junk science'," explained Bruce DeBoskey of the Denver firm of Silver & DeBoskey. But the judge's decision "showed that the claims of cancer causation are based on legitimate, accepted scientific methodologies," he said. DeBoskey is Bendure's co-counsel with John Sweeney of John E. Sweeney & Associates in Agoura Hills, CA.

Dexter Louie of the San Francisco firm of O'Connor, Cohn, Dillon & Barr, which represents Kustom, told *Microwave News* that, "The plaintiff's experts are not basing their opinions on generally accepted scientific principles"; he said that the motion for summary judgment was based on this argument, but he would not comment further. John Warner of Corte Madera, CA, who represents MPH Industries, said he would not discuss the case until after the trial.

Judge Weigel had originally scheduled the defendants' motion to be decided July 9, but he delayed the decision so he could review additional information that he requested from the plaintiff's attorneys. His questions focused on, among other things, the applicability of studies concerning exposure to non-ionizing electromagnetic radiation (NIER) at frequencies other than those used by the radar guns.

In response, DeBoskey and Sweeney wrote that, "There is simply no scientific evidence which supports [the] defendants'

Other Police Radar Developments

60 Minutes Airs Investigative Report

60 Minutes ran its segment on possible health risks associated with hand-held traffic radar as its lead story on June 21.

Correspondent Morley Safer began the piece by interviewing officers from across the U.S., who described how they used the radar. George Nelson of Grand Rapids, MI, for example, explained that he rested the unit in his lap while it was transmitting and he believed the radiation caused his testicular cancer. Toward the end of the piece, Safer included a shot of Nelson and the five other officers in Grand Rapids who have developed testicular cancer (see *MWN*, M/A92).

For two different views on research and regulation concerning health effects from microwave radiation, Safer relied primarily on interviews with Dr. Eleanor Adair of the John Pierce Foundation Laboratory in New Haven, CT and Dr. Louis Slesin of *Microwave News*. The last word, however, was given to Ohio State Trooper Gary Poynter: having described the database in which he records cases of cancer among traffic radar users (see *MWN*, M/A92), Poynter lamented the deaths of many of his fellow officers.

The producers had planned to air the piece in the fall, during the show's regular season, but moved the airdate up because the issue was gaining attention and they feared that others would beat them to the punch. Indeed, in an apparent effort to scoop the top-rated CBS program, *NBC Nightly News* ran a short piece on June 19 by reporter Robert Bazell.

IEEE Reaffirms COMAR's Stance

Even before the *60 Minutes* piece aired, the Institute of Electrical and Electronics Engineers (IEEE) issued a response to the concerns raised by "the allegations of Poynter [which] have been expanded in a series of media events...." The institute reaffirmed its views in an "Entity Position Statement," written by its Committee on Man and Radiation (COMAR), which argues that police radar guns are safe because the power levels are low.

The five-page statement relies primarily on the IEEE's own 1991 microwave exposure guidelines, written by SCC-28, and on the previous ANSI C95.1 limits. It notes that, "The vast majority of police radars operate between 10 and 25 mW, although a small number of 100 mW devices are still in service. By comparison, the power output of a child's walkie-talkie is 35 mW, and cellular hand-held radio-telephones operate at power levels of hundreds of milliwatts."

The IEEE concludes unambiguously that, "There is no scientific basis for worry that exposure to police radar may cause or promote cancer."

FDA: Advice for Police Officers

Also responding to "recent stories in the news media" about possible cancer risks from police radar use, the Food and Drug Administration (FDA) has published a two-page *Update on Possible Hazards of Traffic Radar Devices*.

Written as questions and answers for police officers, the information sheet states repeatedly that there are no proven health risks. But it is less categorical than the IEEE statement and avoids any conclusion that the devices are safe. Referring to a "preliminary comparison" of the number of cancer cases reported by police officers with cancer rates in the general population, the FDA states that this comparison "does not appear to show a greater cancer rate among the police, but it is too soon to conclude that there is no risk." This assessment is partially based on a review of Gary Poynter's database of police officers who developed cancer after using radar.

The update describes a number of precautions that go beyond simply keeping the radar units at least six inches from any part of the body—the advice given in an FDA letter to IEEE's COMAR in June 1991 (see *MWN*, J/A91). The FDA now suggests the following "simple steps" to reduce exposure:

- Pointing the hand-held radars away from the body when they are on;
- Pointing fixed antennas away from the occupants of a patrol car;
- Turning hand-held units off when they are not in use; and
- Not pointing the radars toward metal surfaces in a patrol car.

The FDA sent out copies to police officials across the U.S., urging them to "make this update available to the officers under your jurisdiction." The update also explains that the FDA will "continue to evaluate the research" on microwave radiation and asks police officers to report all cases of cancer among radar users to its toll-free number, (800) 638-6725.

Experts for the Bendure Case

Both sides in the Bendure case (see p.10) have designated their experts—including many who will be familiar to those who have followed previous EMF lawsuits and controversies. The following individuals, among others, have provided testimony or have been listed in court filings as experts who may be called during the trial.

For Kustom Signals and MPH Industries: Dr. Budd Appleton, an ophthalmologist formerly with the U.S. Army Medical Corps; Dr. Roswell Boutwell, McArdle Laboratory for Cancer Research, University of Wisconsin, Madison; Dr. Linda Erdreich, Bailey Research Associates Inc., New York City; Dr. Michael Fischman, Division of Occupational and Environmental Medicine, University of California, San Francisco; Dr. Bill Guy, Bioelectromagnetics Research Lab, University of Washington, Seattle; Dr. Don Justesen, VA Hospital, Kansas City, MO; Dr. Jack Mandel, an epidemiologist in Minneapolis; and Dr. Kristian Storm III, Comprehensive Cancer Center, University of Wisconsin, Madison.

For Bendure: Prof. Leo Birenbaum, Polytechnic University, New York City; Dr. Andrew Marino, Louisiana State University Medical Center, Shreveport; Dr. Samuel Milham Jr., recently retired from the Washington State Health Department; and Dr. Milton Zaret, an ophthalmologist in Scarsdale, NY.

Boutwell, Erdreich and Marino have previously testified in lawsuits concerning power line EMFs; Guy and Justesen have been called as experts in hearings on the siting of cellular and microwave towers. Appleton and Zaret have long held opposing views about the effects of microwaves on the eye. Storm was, for a time, the chairman of the SCC-28 subcommittee that wrote the C95.1-1991 standard.

Alternative Speed Enforcement Methods

Alternatives to traffic enforcement radar guns are discussed in "Improving on Police Radar," a six-page article in the July 1992 *IEEE Spectrum*. The author, Dr. David Fisher of the Michigan State University Radar Testing Laboratory in East Lansing, discusses radar, lasers, video cameras and Vascar (a device that calculates speed based on an officer's visual observations). The focus is on which technology is most effective for catching and prosecuting speeders. Fisher, who has done extensive testing of radar gun emissions (see *MWN*, N/D91), makes no mention of possible health risks from radar.

'divide and conquer' strategy to isolate the narrowest frequency band involved in police radar and ignore the great quantity of scientific evidence at other points along the [NIER] spectrum."

DeBoskey told *Microwave News* that the court had accepted their view that research on radiation at other frequencies is relevant to police radar cases, adding that this decision is in turn important for lawsuits that allege adverse health effects from other types of NIER. "The same types of attacks are going to be made in radiofrequency [RF] radiation cases, power line cases, and so on," DeBoskey said.

Indeed, many participants in the Bendure case have played a role in other legal battles over NIER (see box p.11). Sweeney, a veteran of several military radar cases (see *MWN*, D82), is currently working on two RF/microwave radiation injury claims (see p.1). DeBoskey represented Beryl Main, who alleged that her lymphoma was caused by exposure to RF radiation from an FM radio transmitter operated by Jefferson-Pilot Broadcasting Inc. The case was settled out of court in March 1990 (see *MWN*, M/A87, M/J87, S/O89 and M/J90). DeBoskey is also cocounsel for Nancy Jordan, who has sued Georgia Power Co. and Oglethorpe Power Co., claiming that EMFs from the companies' power lines caused her non-Hodgkin's lymphoma (see p.6 and *MWN*, S/O91).

Bendure worked for the San Anselmo (CA) Police Department from 1985 to 1988 and for the Petaluma (CA) Police Department from 1988 to 1990. During that time, he used several models of Kustom hand-held traffic radar extensively. He was diagnosed in early 1989 with non-Hodgkin's lymphoma. According to his attorneys, the cancer originated in his right groin area near where he rested the radar when it was transmitting but not being used to clock traffic.

Senate Hearing on Police Radar

Sen. Joseph Lieberman (D-CT) is planning to hold a hearing on the health effects of traffic radar on August 10 in Washington.

Those scheduled to testify include: Dr. Ross Adey, Veterans Administration Hospital, Loma Linda, CA; Dr. William Farland, Office of Health and Environmental Assessment, Environmental Protection Agency, Washington; Sam Franzo, International Brotherhood of Police Officers, Rocky Hill, CT; Dr. Brian Hardin, National Institute for Occupational Safety and Health, Washington; Henry Kues, Applied Physics Lab, Johns Hopkins University, Laurel, MD; John Kusek, Kustom Signals Inc., Overland Park, KS; Officer Thomas Malcolm, Windsor Locks (CT) Police Department; State Trooper Gary Poynter, Middleton, OH; and John Rankine, IEEE Standards Board, Washington.

Lieberman is chairman of the consumer and environmental affairs subcommittee of the Committee on Governmental Affairs. Sen. John Glenn (D-OH), the chairman of the committee, is expected to attend the hearing.

When he announced the hearing in May, Lieberman noted that there had been a dearth of research on radar. At the same time, Connecticut's other senator, Christopher Dodd (D), asked Dr. Kenneth Olden, head of the National Institute of Environmental Health Sciences, to urge an epidemiological study of police radar users (see *MWN*, M/J92).

International Commission on NIR Protection Launched

On May 20, the International Radiation Protection Association (IRPA) approved the charter for the International Commission on Non-Ionizing Radiation Protection (ICNIRP), which will continue the work of IRPA's International Non-Ionizing Radiation Committee (INIRC). Dr. Michael Repacholi, chairman of the committee, will lead the commission.

"Non-ionizing radiation protection has come of age," Repacholi told *Microwave News*. Currently a visiting scientist at the Australian Radiation Laboratory in Yallambie, Repacholi said that ICNIRP will now have only a "loose association" with IRPA.

Dr. Mays Swicord, the chief of the radiation biology branch at the Food and Drug Administration's Center for Devices and Radiological Health and an ICNIRP member, predicted that the change "should elevate the status of the committee and provide for greater international coordination."

The commission has an ambitious work plan. Over the next four years, according to Repacholi, ICNIRP will issue separate guidelines for human exposures to static magnetic fields; lasers; ultraviolet (UV) radiation; infrared radiation (IR) and visible light; 0-100 kHz EMFs; and pulsed radiofrequency (RF) radiation. The commission will also publish shorter statements on police radar, mobile telephones (see *MWN*, M/J92) and medical ultrasound.

In association with the United Nations Environment Program (UNEP) and the World Health Organization (WHO), ICNIRP plans to update the volumes of *Environmental Health Criteria* on extremely low frequency (ELF) EMFs, UV radiation and visible light. Working with the International Labor Organization (ILO), ICNIRP plans to issue practical protection guides. These will cover UV and IR radiation for indoor workers, UV radiation for outdoor workers and RF radiation for operators of heat sealers. In addition, ICNIRP, the ILO and WHO hope to jointly publish manuals on the medical handling of accidental overexposures to NIR and on protecting health care workers from NIR.

Most of the members of INIRC have joined the commission. One exception is Sweden's Dr. Bengt Knave, who has stepped down and been replaced by his protégé, Dr. Ulf Bergqvist.

Annette Duchêne, who has served as INIRC's scientific secretary since it was founded in 1977, has announced that she will retire when a replacement is found—until then, she will continue to work with the commission.

In the past, INIRC has issued papers and reports on ELF EMFs (see *MWN*, D84, M/A88, M/J89 and J/F90); static and ELF magnetic fields (see *MWN*, My85 and M/A87); RF/MW radiation (see *MWN*, Mr84 and J/F88); VDTs (see *MWN*, M/A88); and MRI (see *MWN*, J/F92).

The commission members are: Drs. Michael Repacholi (chairman), Australia; Martino Grandolfo (vice chairman), Italy; Ulf Bergqvist, Sweden; Jürgen Bernhardt, Germany; Jean-Pierre Cesarini, France; Louis Court, France; Alastair McKinlay, U.K.; David Sliney, U.S.; Jan Stolwijk, U.S.; Mays Swicord, U.S.; Laszlo Szabo, Hungary; Tom Tenforde, U.S.; Henri Jammet (chairman emeritus), France.

EMF Bioeffects Research *(continued from p.1)*

public concerns"—at least until there is a "broad scientific consensus" that EMFs pose a negligible health threat.

"More bioeffects research is only part of the answer," Florig was quick to point out in a telephone interview. "The public has grown to distrust traditional risk management and is demanding to become more involved in the decision-making process. We must develop new ways to include the public in the resolution of EMF disputes, including the siting of power lines."

Florig outlines six types of economic impacts that are due to concerns about EMF health risks:

1. *Delays, cancellations and moratoriums on new transmission projects*—Industry statistics indicate that utilities are planning about 12,600 circuit-miles of new transmission lines through the year 2000.
2. *Loss of property value*—Florig estimates that a loss of even 1% in the value of homes and land close to transmission lines amounts to a market loss of about $1 billion.
3. *Litigation costs and awards in suits claiming EMF-induced health damage from power lines and appliances*—For instance, a Texas jury awarded a school $25 million (later reversed) in a dispute with Houston Light & Power Co. (see *MWN*, N/D85, N/D87 and M/J89).
4. *Low EMF designs implemented by utilities, such as burial or new line configurations*—Florig writes that these changes are adding up to $1 billion to the $13 billion a year that U.S. utilities are investing in transmission and distribution construction.
5. *Changes undertaken by the public and businesses to reduce EMF "hot spots"*—According to one estimate, reducing magnetic fields in offices can cost up to $400 per square meter.
6. *The production costs of low EMF household and office appliances*—Florig predicts that the $2 billion-a-year market for video display terminals and the $100 million-a-year market for electric blankets will soon be limited to low magnetic field models.

Even in the face of competing claims for federal research dollars for other environmental risks, Florig finds that, "The need for a stronger federal program of EMF research is particularly acute."

See Keith Florig, "Containing the Costs of the EMF Problem," *Science, 257*, pp.468-469, 488-490, July 24, 1992.

RF/MW Radiation Litigation *(continued from p.1)*

The defendants—AT&T, GTE Products Corp., Lockheed Electronics, GE and Raytheon—pushed to have Ford's suit dismissed, arguing that microwave radiation should not be classified as a toxic "substance." The court disagreed.

"The defendants' attempt to limit the statute...[flies] in the face of the legislative intent to expand the rights of persons injured by the latent effects of exposure to any substance," Lehner wrote in his decision.

If a chemical or physical agent is deemed a substance, a plaintiff has three years from the time an injury is *diagnosed* to determine the cause and file a claim, explained Kenneth Henrie of Henrie & O'Boyle in Wantagh, NY, Sweeney's local co-counsel. If the radiation had not been ruled a substance, Ford's case would have been subject to a statute of limitations giving him only three years from the time the exposure *occurred* in the 1960s to begin his suit.

A spokeswoman for AT&T said that the company is studying the June 30 decision and has not yet decided whether to appeal.

"This case could open up a real Pandora's box," Henrie said. "It's the beginning of the new wave of litigation for the 21st century." Sweeney told *Microwave News* that he thinks the ruling is "likely to resolve the same claim made by the defendants in the Dowgiallo case." Sweeney also represents Michael Dowgiallo, an electrician who filed a product liability lawsuit alleging that RF/MW radiation from an FM antenna and from a microwave transmitter caused his stomach cancer (see *MWN*, N/D90).

For more on RF/MW litigation, see *MWN*, M/J86, S/O86, M/A88, M/J89 and S/O89.

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FROM THE FIELD

EMFs and Cancer Rates

To the Editor:

In a paper published in the April 1992 *Proceedings of the National Academy of Sciences*, physicist J.D. Jackson asserts that there can be no cancer risk from exposure to power frequency electromagnetic fields (EMFs) because use of electrical power has increased markedly in the last 50 years while cancer risk apparently has not. Problems in his epidemiologic argument have already been noted (see *MWN*, M/J92). Perhaps less evident is his unfamiliarity with how power distribution practices affect the EMF exposure associated with power use.

Dr. Jackson unquestioningly assumes that power frequency EMF exposure increased proportionately with increasing power use over the last 50 years. The fact, however, is that numerous engineering changes have occurred over the years that markedly *decreased* the level of magnetic field exposure likely to accompany a given power use (and it is the magnetic field exposure that has been most clearly implicated by studies suggesting cancer risk). These changes include:

1. Use of higher voltage in primary distribution lines, allowing more power to be transmitted for the same amount of current (it is the current that produces a magnetic field);
2. Use of Romex instead of knob-and-tube wiring inside the home (greater cancellation of fields from current flow within the house);
3. Use of triplex rather than spaced secondary wires (greater field cancellation);
4. Increased use of 240-volt appliances, which generally use a lot of power, but have less potential for producing ground currents than do 120-volt appliances (ground currents within the house are a major source of magnetic field exposure);
5. Increased use of two secondary wires of opposite polarity, instead of only one "hot" wire, to serve homes (greater cancellation of in-house fields from ground currents);
6. Increased use of nonconductive elements (nonmetallic pipe, nonconductive joints, service insulators, etc.) in the plumbing system to which electric power is grounded. *This practice is especially important because it generally prevents injection of neutral currents into the plumbing system, which is arguably the most important underlying cause of magnetic field exposure within a house—both from ground currents flowing through the house and from the resulting net currents on distribution lines running past the house.*

These considerations (especially the last) seem largely to explain why, in the Savitz data, homes in newer suburban areas (where many people live today) clearly show *lower* magnetic field measurements than homes in older suburban areas. Thus, in spite of increased power use, it is likely that magnetic field exposures associated with power distribution have decreased, if anything, over the years for which reliable cancer data are available—at least in the Denver area, and probably nationwide.

Nancy Wertheimer, PhD
Ed Leeper, MA
Boulder, CO

UPDATES

CELLULAR COMMUNICATIONS

Court Blocks Cellular Transmission Tower... Opponents of a proposed 300-foot tower near Butler Township, PA are expressing confidence that they can stop the project. A Pennsylvania Common Pleas Court judge ruled in their favor on May 26, denying a request by Bell Atlantic Mobile Systems Inc. to reverse a decision by the Butler Township Board of Commissioners, which rejected the company's application for a development permit last January. The judge, George Kiester, believes an appeal is likely, according to an account in the May 28 *Butler Eagle*....A tower proposed by Cellular One is meeting with disapproval among residents of Old Chatham, NY. Three letters to the editor published in a local newspaper, *The Independent*, on May 28 expressed skepticism about the company's assurances that the tower would pose no health threat. The facility is aimed at improving cellular phone coverage for motorists on several major highways in the area, leading to the complaint in one letter that, "It seems to us that the main beneficiaries will be cars and trucks on I-90...."

MEASUREMENTS

RF/MW Standard Approved...ANSI has approved a new standard, ANSI/IEEE C95.3-1992, *Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields—RF and Microwave*. It is available for $54.00 from: IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08855, (800) 678-4333.

Swiss RF/MW Report... An advisory group to the Swiss Federal Office for Environment, Forests and Landscape has published *Non-Ionizing Electromagnetic Radiation Measurements—Part 1: Frequency Band 100 kHz to 300 GHz*, Environmental Protection Document No. 164. For a copy of the report, contact: P. Roch, OFEFP, Hallwylstrasse 4, 3003 Bern, Switzerland, (41+31) 616964; include a self-addressed mailing label with your request. The report is only available in French or German. In 1990, this advisory group endorsed IRPA's standards for human exposure to RF/MW radiation (see *MWN*, J/A90).

ELF and RF Body Current Meters... Holaday Industries Inc. has introduced two new products: a 3-axis ELF magnetic field meter and an induced body current meter. The ELF meter, HI-3627, measures 30 Hz to 2 kHz magnetic fields from 0.2 mG to 20 G. It is similar to the HI-3624, but can give a true rms reading, according to Holaday's Dave Baron. It costs $1,495. Holaday's HI-3701 meter can measure body currents induced by 3 kHz to 100 MHz radiation. The device, which looks like a bathroom scale, can be used to judge compliance with the 1992 IEEE/ANSI RF/MW exposure standard. Although the unit was based

on the research of Dr. Om Gandhi of the University of Utah (see *MWN*, J/A85), Holaday designed it independently, Baron said. The HI-3701 costs $3,495.

RADAR

NEXRAD Environmental Report... The WSR-88D radar—better known as NEXRAD—will have "no significant adverse environmental impacts," according to a draft environmental assessment issued by the National Oceanic and Atmospheric Administration (NOAA) in April. The report also asserts that transmission lines built to power the radar will not threaten public health. The study, prepared by SRI International in Menlo Park, CA—which has also prepared environmental assessments for the U.S. Air Force—concedes that RF radiation can cause biological changes by heating molecules in the body, but states that WSR-88D emissions "add heat at rates well below the human body's ability to dissipate heat." Studies that have shown that RF radiation can affect the blood–brain barrier, brain waves and the heart without exceeding this heating threshold were later found to have been "obtained erroneously," according to SRI. The WSR-88D radar will use microwaves in the 2.7-3.0 GHz frequency band, with a maximum peak radiated power of 475 kW and an average radiated power of 1 kW or less. Exposures will not exceed the guidelines adopted by the IEEE's SCC-28 in 1991 (see *MWN*, N/D91). Worldwide, 173 sites have been selected for the WSR-88D radars. Ten have been built, of which two are operating in a "testing mode," according to Andrew Anderson, a NOAA engineer. The agency is revising the draft assessment and a final report is expected by the fall, Anderson told *Microwave News*. To order a free copy of the draft *Supplemental Environmental Assessment of the Effects of Electromagnetic Radiation from the WSR-88D Radar*, contact: Andrew Anderson (15204), NOAA, NEXRAD JSPO, 1310 East West Highway, Silver Spring, MD 20910, (301) 713-0144. For more on NEXRAD, see *MWN*, M/A92.

STANDARDS

Puerto Rico Adopts RF/MW Rules... Responding to a "proliferation" of new radio, television, microwave and cellular telephone towers, Puerto Rico's planning board has developed new RF/MW exposure limits and criteria for siting telecommunications facilities. Signed by Governor Rafael Hernández-Colón on June 4, the new rules follow the outline of the National Council on Radiation Protection and Measurements (NCRP) standard for the general public—for example, 200 $\mu W/cm^2$ at 30-300 MHz and 1 mW/cm^2 at 1.5 GHz. A more stringent 10 $\mu W/cm^2$ limit had been included in a previous draft of the rules, but this had been sharply criticized by some in the cellular phone industry. "We impressed on [the planning board] that we preferred the ANSI or NCRP guidelines," said William King, president of CCPR Services Inc., an independent company that operates in Puerto Rico under the Cellular One name. King told *Microwave News* that 18 applications for new cellular transmission facilities filed by his company since 1990 had been held up pending enactment of the new rules.

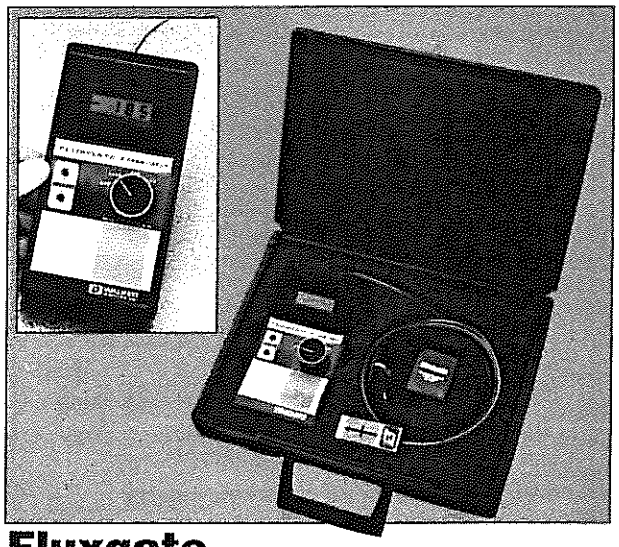
ETC...

The View from Hollywood... If anyone doubts that EMFs have yet to permeate American culture, take a trip to the local cineplex and see *Honey, I Blew Up the Kid*, one of this summer's biggest hits. After the "kid" is accidentally hit with a high-tech laser beam—which puts him on a fast-track growth curve—his condition is aggravated by EMFs from a microwave oven, a TV and, of course, a high voltage power line.

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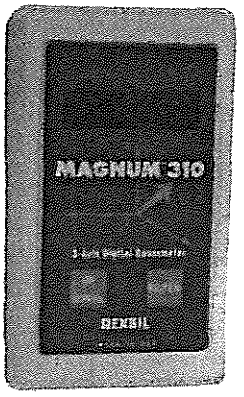
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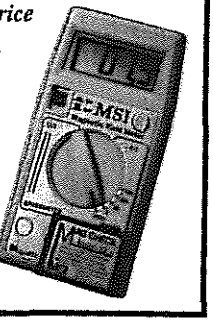


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German Animal Studies Support EMF–Breast Cancer Link

A Boost for the Melatonin Hypothesis

German scientists have found strong support for the proposition that electromagnetic fields (EMFs) can promote breast cancer. In a series of animal experiments, they have shown that magnetic fields can magnify the action of a chemical carcinogen, increasing the incidence of breast tumors. They have also thrown some light on a possible mechanism by showing that the EMFs reduced the animals' melatonin levels.

In a paper that appears in the July 30 issue of *Cancer Letters*, Dr. Wolfgang Löscher and coworkers at the School of Veterinary Medicine in Hannover report that long-term exposure to 50 Hz magnetic fields "promotes the growth and increases the incidence of mammary tumors." This finding, they say, "strongly [indicates] that magnetic field exposure exerts tumor-promoting and/or co-promoting effects."

Löscher continuously exposed 99 rats that had been treated with DMBA, a known carcinogen, to a 1 G magnetic field for three months and found that 50% more rats developed tumors than did others who were only treated with DMBA. The increase is statistically significant. Löscher is in the process of repeating the study using 100 mG. "If we find something, we'll try 10 mG," he told *Microwave News*.

(continued on p.13)

EPA Scales Back Cancer Review, To Eliminate EMF & RF/MW Programs

The Environmental Protection Agency (EPA) will not revise its 1990 report on the possible cancer risks associated with electromagnetic fields (EMFs). Instead, the agency will prepare a 30-page summary of the scientific data. This is scheduled for release at the end of 1993 or early in 1994.

At the same time, EPA's Office of Radiation and Indoor Air (ORIA) is proposing to phase out practically all work on non-ionizing electromagnetic radiation (NIER)—including both EMFs and radiofrequency and microwave (RF/MW) radiation—as part of the President's plan to reduce the budget deficit. If the ORIA budget is adopted, by fiscal year 1995, which begins on October 1, 1994, there will be only one staff position in the entire agency for these programs. They are vulnerable to budget cuts, according to EPA managers, because they are discretionary, with no specific congressional mandate.

"We thought it would be a duplication of effort to revise the cancer document," Dr. Robert McGaughy, a senior scientist at EPA's Office of Health and Environmental Assessment (OHEA) responsible for the report, told *Microwave News*. He cited the similar efforts under way by the National Council on Radiation Protection and Measurements and by the National Academy of

(continued on p.14)

« Power Line Talk »

What will it take to convince skeptics that there is indeed an EMF–cancer connection? Dr. **David Bates**, a highly regarded Canadian epidemiologist, says that only a prospective occupational study will do the trick. Countering the popular opinion that animal studies are the missing link, Bates points to Sir Richard Doll's prospective study of smokers as having turned the tide against cigarettes. In his opening address to the **Bioelectromagnetics Society**'s annual meeting, in Los Angeles in June, Bates said that the current EMF evidence is not strong enough to shift the burden of proof for establishing safety onto the electric utilities. On the other hand, he argued that it is entirely proper to take protective steps before understanding the mechanism of action. One should not have to wait until all the data is in hand, he said — after all, no one yet knows why cigarettes and asbestos act synergistically to magnify cancer risks. Bates, an emeritus professor of medicine at the University of British Columbia in Vancouver, Canada, recalled that he advocated taking the lead out of gasoline as early as 1972, long before this view became the prevailing public policy. He also urged people to be wary of those who sum up the epidemiological evidence with phrases such as "no scientific proof that..." or "no objective evidence of...." Whenever one hears such phrases, Bates advised, it is a good idea to seek some clarification. In an interview with *Microwave News*, Bates endorsed a policy of prudent avoidance—citing as an example a hospital in Seattle where exposures reached 100 mG. "That's too high," he said; he suggested converting the area into a storeroom. But, on further questioning, he declined to specify a level that he would consider safe. Bates said the epidemiological data have gained consistency and are more biologically plausible than in 1990 when the EPA released its EMF–cancer assessment. Bates was the vice chair of the committee that reviewed the document for the Science Advisory Board (see *MWN*, J/F 91). Bates cautioned that a prospective study of EMF-exposed workers would take a long time, but, he said, there really is no other choice because "no animal study can tell you enough." (Much of Bates's speech was drawn from a series of lectures he gave at the University of Washington, Seattle, last March, which will be published later this year by the University of Washington Press.)

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Somewhere in the budget process, the national EMF research and communications program (**NERP**) lost $5 million and no one seems to know how or why. Last year's Energy Policy Act mandated $13 million a year, for five years, for the NERP, but that amount has now shrunk to $8 million—and it could easily shrink further in the budget battles to come. When details of the President's 1994 budget first leaked out earlier this year, we were told that the NERP would get $12 million: $6 million from Congress, to be matched by $6 million from industry. At the same time, **DOE**'s ongoing research effort was to get $4 million. When the House passed its appropriations bill in June, the NERP and DOE figures were switched. Cutting $2 million from the NERP budget will cost the program another $2 million in industry matching funds. Last November, at the annual DOE EMF research review in San Diego, DOE's Robert Brewer told us emphatically that there would only be one EMF research effort, the NERP (see *MWN*, N/D92). The DOE program appears to have made a surprising comeback. It is now bigger than the much-touted national program. DOE officials say there never was a switch and that now nothing can be done to reallocate the money. After all, they argue, if anyone rocks the boat at a time when budgets are being slashed, they risk losing everything. In an interview, **James Cunningham** of the New York Power Authority, who lobbied hard to enact the NERP, expressed frustration over the budget cuts and the slow progress. "The intent of Congress was clear," he said. "The program should be fully funded." He warned that, "The public wants answers and wants them soon." Nothing is certain until the Senate acts and the House and Senate agree on a compromise. The Senate may in fact be sympathetic to the need for the NERP. Last August, 15 senators signed a joint letter calling the NERP "imperative." They also specifically supported the designation of NIEHS as the lead agency for carrying out EMF research. The new NERP advisory committee is writing a letter to the Senate Appropriations Committee stressing the need for a full program. At its first meeting on August 5-6, **Shirley Linde** of Citizens for Safer EMFs, in Los Angeles, was elected chair of the committee and **John Coughlin**, a commissioner at the Wisconsin PSC, was elected vice chair. The committee's next meeting is scheduled for November 4-5 in Savannah, GA, following the DOE contractors' review (see *MWN*, M/A93).

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A British couple has filed a suit alleging that their 13-year-old son's leukemia was caused by EMFs from a nearby substation, buried power lines and household wiring, according to British news reports. If brought to trial, this case would be the first of its kind in the **United Kingdom**. In mid-August, the family won legal aid to pursue the case—legal aid is provided to those who can demonstrate an economic need and can show that their claim has merit. **Simon Studholme**, who died last year, was diagnosed with leukemia 19 months after the family moved into a home near Manchester, in northern England. A survey of the family's home by Alasdair Philips, an electronics engineer, indicated that the magnetic fields in the boy's bedroom were "ten times the level[s] American and Swedish studies had linked to an increased risk of childhood leukemia," according to the August 23 *Daily Telegraph*. (Roger Coghill of Coghill Research Labs in Gwent, Wales, has also done measurements in the Studholme home.) Simon's father, Ray Studholme, is also seeking damages for his 12-year-old daughter's epilepsy, and he wants Norweb, the local electricity company, to reduce the EMFs in his home. On August 22 the *Sunday Times* reported that Norweb denies liability and refuses to mitigate the EMFs. Ray Studholme, who is being represented by attorney **Martyn Day** of the London firm of Leigh, Day & Co., argues that if his family had been warned, their son would not have slept so close to the household electric meter, which was located on the other side of the wall next to the boy's bed. In the past, Day has worked on ionizing radiation cases. The Studholmes' argument is similar to the

claim made by the **Zuidema** family in the U.S. The Zuidemas—whose daughter developed a rare kidney cancer—argued unsuccessfully that San Diego Gas & Electric had had a duty to warn its customers about the potential health effects of EMFs (see *MWN*, M/J93). On August 23 the London *Times* speculated that, "The case could lead to scores of similar claims, forcing electricity companies to monitor thousands of homes and eliminate any risk from pylons and substations, at huge expense."

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The **DOE** has declined to initiate a nationwide EMF survey of schools near power lines, as was requested by New York State Attorney General **Robert Abrams**. Instead, the question will be left to NERP policymakers. "Decisions to conduct nationwide surveys of particular field sources, such as transmission line fields near schools, will be made a part of this national effort," wrote DOE's Dr. **Robert San Martin**, acting assistant secretary of energy efficiency and renewable energy, in a July 7 reply to Abrams. The attorney general had written to Energy Secretary **Hazel O'Leary** on June 22, asking that she "use the power and influence" of her office to urge utilities across the country to conduct EMF surveys at schools. "The time is ripe for the DOE to take a strong national lead on this issue," Abrams wrote. The call for a national effort came as New York was finishing its own schools survey—a similar effort is under way in New Jersey and another has been proposed in Maryland by state Delegate **Joan Pitkin**. The California Department of Education's EMF–schools task force is considering a proposal by Dr. **Raymond Neutra** of the Department of Health Services and utility representatives to identify schools that are near transmission lines. Of the more than 6,000 schools in New York, 115 are near high voltage overhead power lines, and 24 are thought to have EMFs in excess of 2 mG, according to a report released by Abrams on July 22. The levels were calculated with computer models—on-site measurements have not yet been taken. The highest peak levels, 35 mG and 33 mG, were found at schools in Westchester and Erie Counties, respectively. School officials now have the option of requesting on-site measurements by the utilities that operate the lines, "so that the public may be fully informed about the potential for EMF exposure," according to Abrams. The majority of the 24 schools are located near power lines operated by Consolidated Edison Co., Long Island Lighting Co. or Niagara Mohawk Power Corp. (For more on New York's EMF survey, see *MWN*, N/D92, M/A93 and M/J93; for more on California and EMFs in schools, see *MWN*, M/J88 and M/J93.)

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An ad in the July/August issue of ***E Magazine***, an environmental bimonthly, introduces a new, bimonthly "consumer newsletter for electric and magnetic fields." Our interest piqued, we decided to find out who is behind the new publication, which has the provocative name ***EMF: Between the Lines***. Subscription inquiries are directed to the Center for Energy Information in Augusta, ME. At the bottom of the ad is this statement: *"EMF: Between the Lines* does not accept any form of advertising, endorsement, or sponsorship." It turns out that, such a statement of independence notwithstanding, the Center for Energy Information is a division of **Central Maine Power** Co. (CMP). The utility's name does not appear anywhere in the ad. It does appear, however, in a smaller ad that ran in the September/October issue of *E*. "It took us a while to put two and two together that it was CMP," the magazine's associate publisher, Deborah Kamlani, told *Microwave News*. But when payment for the first ad arrived, the check was from CMP, and Kamlani asked *EMF: Between the Lines* to name CMP in any future advertising. Judy Franke, editor of the newsletter, asserts that the utility was not mentioned in the initial ad because "the management of CMP has no say whatsoever in what we do." Franke described the Center for Energy Information, which also publishes a biweekly industry newsletter, *EMF Keeptrack* (see *MWN*, J/F92), as "an independent information brokerage company." CMP will probably not be mentioned anywhere in the newsletter itself, Franke said, though a final decision has not been made. The first issue will come out in September. If you read carefully—between the lines, one might say—there is a clue in the original ad in *E* that a utility is involved: the address for the Center for Energy Information is on Edison Drive.

"It's the Wires"

The following is excerpted from an article, "The Devil in Long Island: What's possessed this once-somnolent suburban realm and turned it into a tabloid pandemonium of spouse-slayers, serial killers and demented dungeon-builders?" It was written by Ron Rosenbaum and appeared in The New York Times Magazine *on August 22. Parts of New York City as well as Nassau and Suffolk Counties are on Long Island.*

Why is this Island different from all other islands? And why are so many Long Islanders suddenly running amok?

The question of Long Island uniqueness was posed in a particularly acute way by one of the characters on one of those three Amy Fisher-Joey Buttafuoco made-for-TV movies.

The scene: The interior of Joey's Complete Auto Body Shop. One of Joey's employees is theorizing about the deep, underlying source of the love triangle shooting. He's obviously given some thought to the vexing question, attributing it to "Mid-Island Syndrome."

"It's the wires," he declares. "The wires weren't buried underground like in other parts of the country, so with all this electricity in the air, it fries some people's brains."

Now there are some practical objections to this theory. A Lilco spokeswoman, after checking with the Long Island power company's electric service operations department, insisted that Long Island does not differ from the rest of the nation in the way it deploys its high-tension lines and that, in fact, more are buried than exposed. Still, the power line explanation at least attempts to offer a unified field theory of Long Island mania. And even the Lilco spokeswoman, perhaps attempting to divert attention from the power lines, offered an implicit endorsement of the quest for *some* explanation.

"Now the water—that's another story," she said.

Rhode Island Governor Vetoes Bills To Bury Power Lines

Rhode Island nearly became the first state to prohibit the construction of overhead transmission lines near homes and schools. At the last minute, the state senate reversed itself and decided not to override a veto by Democratic Governor Bruce Sundlun.

A bill introduced by Sen. Mike Lenihan (SB570) would have forced new power lines of at least 69 kV near residences and schools to be built underground. A companion measure in the house, sponsored by Rep. Russell Bramley (HB6882), would have required that *all* new lines of at least 69 kV be buried.

In his veto messages for both bills, Sundlun said that evidence of an EMF–cancer link is "weak, inconsistent and inconclusive," and that "most scientific studies do not support the findings that would be recognized and adopted" if the bills were to become law. He argued that high voltage transmission lines represent "a small fraction" of public exposure to EMFs, that the measures would not significantly reduce such exposure and that burying power lines would increase electricity costs in the state. Bramley's bill passed the house 78-7 and was vetoed on July 21. Lenihan's measure was vetoed on July 13, about a month after it had passed the senate 25-19.

On July 19, the senate voted 28-16 to override the veto of Lenihan's bill. But later that day, after a motion was made to reconsider, the senate fell short of the three-fifths majority necessary for an override and the veto held. Lenihan said that he thinks the reversal was unconstitutional and he attributed the switch to aggressive lobbyists "who got five or six people to change their minds" during a break after the first session. Ed Seiler of Rhode Islanders for Safe Power, which actively supported the bills, called the move "Rhode Island corruption at its worst," adding that opponents of the bill "didn't win [the decision], they stole it."

The Providence-based Narragansett Electric Co. does not claim credit for the override. After losing the first vote, its lobbyists went home, according to the utility's associate counsel, Ronald Gerwatowski. "But we were delighted with the result," he said, adding that the legislation is "unnecessary because the science to date doesn't support the conclusions that there are adverse health effects from power line EMFs, and [burying the lines] would add to the costs of electricity in Rhode Island, which are already high."

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Kevin Brubaker, an environmental policy analyst for the governor, said that Sundlun's legislative director and staff were present during both override votes, and that it would be "fair to conclude that they were communicating the governor's views on the issue." He argued that the switch was not unconstitutional.

On July 22, the house overrode Sundlun's veto of Bramley's bill, but the session ended before the senate could vote on it. The house bill was thought to have much less of a chance than Lenihan's, because it was the more far-reaching of the two bills. Bramley and Lenihan, both of whom are Democrats, said that they will introduce similar measures again next year. "We're going to keep knocking at the door until someone opens it," Lenihan said.

California PUC Judge Issues Long-Awaited EMF Proposal

After two and one-half years of workshops, meetings and paperwork, a California administrative law judge has decided that EMFs from new power lines should be reduced by at least 4%—as long as the cost of doing so is no more than 4% of a project's total budget.

The July 12 proposal by Public Utilities Commission (PUC) Judge Michael Galvin still must be approved by the four-member commission, which could elect to adopt all, part or none of the plan. The commissioners are scheduled to meet on September 17.

Galvin's 57-page decision is based, in part, on a set of proposals for a state EMF policy devised by a PUC consensus group made up of utility representatives, government health officials, ratepayers, environmentalists and union members. The plan was presented to the PUC on March 20, 1992 (see *MWN*, N/D91 and M/A92).

Galvin also recommended the following:

- A $5.6 million, four-year "nonexperimental" state research program to review policy options and mitigation strategies;
- A maximum $4.1 million contribution to the national EMF research and communications program;
- A $1.6 million, four-year California education program;
- An EMF "Stakeholder Advisory Committee" to monitor and report on the state research program.

Overall, the proposal received mixed reviews from members of the consensus group. But Galvin's plan to reduce EMFs by 4% faces widespread opposition.

Southern California Edison's Jack Sahl supports the decision to cap the cost of EMF reduction measures at 4%, but said that mitigating EMFs by at least 4% would be "administratively unwieldy, because of the burden of having to determine what 4% is." Sahl also criticized what he called a "cookbook" approach to controlling power line EMFs, advocating instead project-by-project evaluations, which would put greater emphasis on community input when deciding on reduction levels.

Ellen Stern Harris of the Fund for the Environment in Beverly Hills opposed the selection of the 4% cost and reduction thresholds, saying that they "make no sense" and represent

"tokenism at its worst." Harris also said that she was "shocked" that the proposal does not order retrofits to reduce EMFs on existing power lines.

The PUC's Division of Ratepayer Advocates (DRA) called Galvin's proposal to cut magnetic fields by 4% "confusing" because "there is no cost–benefit analysis in the record to support this number," according to its formal comments to the PUC. The DRA also recommended a policy that "explicitly requires the utilities to reduce EMF fields as much as possible, but at least by the adopted minimum."

DRA's Diana Brooks endorses Galvin's decision to deny the utilities' request that the PUC approve the way they choose to implement EMF reduction measures. "The bottom line is that the onus is still on the utility," she said, explaining that without validation by the PUC, utilities will have to answer to their local communities.

Galvin's order states that utilities will decide how to carry out the "low-cost" EMF reduction measures, and that they will be able to choose which projects should be exempt—for example, a new power line built in a rural area.

Fresno School EMF–Cancer Case Dropped, But More May Follow

The family of a former teacher at the Slater School in Fresno, CA, has dropped its suit against Pacific Gas & Electric Co. (PG&E), but another EMF–cancer case against the utility is pending and more may soon follow.

The Slater School was first put in the spotlight by Paul Brodeur in a December 7, 1992, article in *The New Yorker*. Brodeur drew a connection between a high rate of cancer among teachers and EMFs from power lines outside the school and criticized the cluster investigation by the California Department of Health Services (DHS) (see *MWN*, N/D92, J/F93 and M/A93).

The first suit, which was filed by the family of Katie Mae Alexander, a former teacher at the school, was dropped amid a shuffling of lawyers. Alexander died in April 1991 at the age of 53 from a brain tumor her family says was caused by EMFs from PG&E power lines. The teacher had worked in classrooms on the south side of the school, nearest the 115 and 230 kV lines.

The suit was filed on April 21, 1992, by Haskell Shapiro, now of Shapiro & Hickman in Los Angeles. But the family replaced Shapiro after learning that he had not prepared for the case and had missed several appointments and deadlines, according to Tommie Nellon, Alexander's son. The family also asked for a continuance while it searched for a new attorney. Shortly before the July 26 trial date, after a Fresno County Superior Court judge denied the request, the family accepted PG&E's offer to waive legal expenses in return for their dropping the suit permanently.

A second claim, filed by Shapiro in February 1993, was taken over by Joe Davis of the Los Angeles firm of Davis & Winston on August 6. This suit was brought on behalf of former assistant principal Curtis Hurd, who joined Slater in 1986 and died of colon cancer in February 1992 at the age of 43. In a telephone interview, Davis said that several more Slater staff, students and community members want to file similar suits against PG&E, and that their actions will most likely be consolidated with the Hurd case.

PG&E's lawyer, Roger Rizzo of Sedgwick, Detert, Moran & Arnold in San Francisco, said that the Alexander and Hurd claims are without merit, and that similar future cases will have little chance. "I don't think that anyone will be any more successful than Alexander was," he told *Microwave News*. Rizzo maintained that Alexander's claim was "completely inaccurate" and said that the utility's twelve expert witnesses were prepared to testify that EMFs do not cause cancer. PG&E had also taken depositions from four "neutral, unpaid" physicians who treated the teacher and who stated that her cancer was not caused by EMFs, Rizzo said.

Danish Government Finds No Need for EMF Exposure Limits

The Danish Ministry of Health has decided that there is "no scientific reason" to set standards limiting exposure to power line EMFs, according to a report published in May.

A group of experts convened by the ministry determined that while the Swedish and Danish epidemiological studies completed last year (see *MWN*, S/O92 and N/D92) "support the hypothesis of previous studies that children living near high-current [facilities] have an increased frequency of cancer," they do not provide strong enough evidence of an EMF–cancer link to merit setting exposure standards. "Neither the earlier nor the latest studies offer sufficient documentation to characterize 50 Hz magnetic fields in homes adjacent to high-current electricity supply [facilities] as a cancer-inducing factor among children," the report states, noting that the observed increased risk might be due to chance.

These conclusions stand in contrast to those reached by the Swedish government. Last fall, Sweden's National Board for Industrial and Technical Development, NUTEK, announced that it would "act on the assumption that there is a connection between exposure to power frequency magnetic fields and cancer." Officials are now in the process of drafting a proposal for a national magnetic field exposure limit for new power lines and substations (see *MWN*, S/O92 and M/J93).

In reaching its decision, the Danish group also focused on the review by the U.K.'s National Radiological Protection Board (see *MWN*, M/A92).

The group of experts was chaired by Professor Carl Wandel of Aarhus University in Aarhus, Denmark. To order a copy of the report, *Rapport om Risiko for Kraeft hos Born med Bopael Eksponeret for 50 Hz Magnetfelter fra Hojspaendingsanlaeg [Report on the Cancer Risk for Children in Homes Exposed to 50 Hz Magnetic Fields from High-Voltage Power Systems]*, contact the expert group at the health ministry at: Sundhedsstyrelsens 1. Afdeling, Amaliegade 13, 1012 Copenhagen, Denmark, fax: (45) 33 93 15 63.

With respect to Hurd's case, Rizzo said that the assistant principal had worked about twice as far away from the power lines as Alexander did. He was exposed to "very, very low levels of EMFs, not unlike what people across the country are exposed to every day," Rizzo said.

Early in 1991, the DHS was asked to evaluate a possible cancer cluster at the Slater School, after teachers there had raised concern about power line EMFs. The DHS released a report this June which concluded that 13 cases of different types of cancer among Slater School staff—about twice the expected number—were probably due to chance. "Past experience has been that in suspected cancer clusters for which a probable cause has been found, the cancers have all been of the same kind...[and] there was a large excess of cancer cases, twenty to thousands of times higher than the expected number," the report states. It also notes that there have been no reported cases among Slater staff of leukemia or lymphoma, "the types of cancer most commonly reported associated with EMFs." Eleven of the 13 staff members with cancer worked in classrooms on the south side of the school, near the power lines.

Davis argues that the DHS may have underestimated the number of cancer cases at the school because researchers failed to locate or contact half of the 195 teachers, aides and administrators who worked at Slater between 1972—when the school opened—and 1993. He also said that additional cancer cases have been reported in the short time since the study was published.

The report answers this criticism by stating that even if more cancer cases came to light, "there would still not be the 20 to thousandfold excess" characteristic of clusters with a known cause. In August, Dr. Eva Glazer of DHS's cancer surveillance section, who cowrote the report with Dr. Raymond Neutra, chief of the department's Environmental Health Investigations Branch, did confirm a 14th cancer case.

Investigators found that in the section of the building closest to the power lines, magnetic fields did not exceed 2 mG on most days and reached a long-term average of about 1 mG, according to the report. The study noted that there are "periods of time" when fields can reach up to 5 mG in these rooms. In the single classroom nearest the lines, levels were estimated to have been above 2 mG 29% of the time.

HEI Completes Research Plan

In June, the Health Effects Institute (HEI), based in Cambridge, MA, released its much-delayed EMF research plan. The 131-page document outlines a five-to-seven-year program with a price tag of about $60 million, detailing specific research areas.

"HEI is prepared to do the research," according to a statement from the HEI board included in the document. "But the important thing is that a carefully formulated strategy for five to seven years of interdisciplinary research be carried out under some central direction," the board concluded. HEI does not currently have any funding for EMF research. "If people say that the folks who put that research plan together ought to be the ones to carry it out, I guess they'll come to us," explained Dr. Charles Powers, founder and acting president of the institute.

HEI began developing this plan in 1990, with funding from the Environmental Protection Agency, the Large Public Power Council, the Los Angeles Department of Water and Power and Seattle City Light. A draft of the plan completed in 1990 was rejected by HEI's board, which asked for a revision with broader context and "clear expressions of priority," according to Andrew Sivak, then president of the institute (see *MWN*, N/D91).

For a copy of *Do Electric or Magnetic Fields Cause Adverse Health Effects? HEI's Research Plan to Narrow the Uncertainties*, contact: HEI, 141 Portland St., Cambridge, MA 02139, (617) 621-0266.

The following expert witnesses had been scheduled to testify for the Alexanders: Dr. Samuel Milham, formerly of the Washington State Department of Health in Olympia and Dr. Peter Wright of the Poly Clinic in Seattle. PG&E's expert witnesses were to have included: Dr. Edwin Carstensen of the University of Rochester, NY, Dr. Philip Cole of the University of Alabama, Birmingham, Dr. Mark Mandelkern of the University of California, Irvine, and Michael Silva of Enertech Consultants in Campbell, CA.

FROM THE FIELD

SCE Cancer Study of Electric Utility Workers: An Exchange

Earlier this year, a team of researchers led by Jack Sahl of Southern California Edison Co. (SCE) in Rosemead published an epidemiological study—J.D. Sahl, S. Greenland and M.A. Kelsh, "Cohort and Nested Case-Control Studies of Hematopoietic Cancers and Brain Cancer Among Electric Utility Workers," Epidemiology, 4, *pp.104-114, 1993—which found no consistent association between on-the-job EMF exposures and mortality from leukemia, brain cancer or lymphoma (see* MWN, *M/A93). Dr. Sam Milham has voiced concern over certain aspects of the study. His detailed argument is reprinted below, together with a response by Sahl and coworkers.*

To the Editor:

In the course of my recent EMF expert witness work, I have been questioned at length about the "negative" EMF–cancer study of the SCE utility workers cohort. There are a number of findings in the report which make me question its negativity.

1) On p.107, the last sentence of the case–control occupational history assignment section states, "Of the occupational assignments, 21% among cases and 17% among controls were 'electrical occupations.'" Cases were utility workers dying of leukemia, brain cancer and lymphoma.† There were 773 male cases (Table 1, p.106). The number of "electrical workers" dying of leukemia, brain cancer and lymphoma is simply calculated as 0.21 times 773 or 162.3, while the expected number is 0.17 times 773 or 131.4. The difference between the observed and expected electrical workers among the cases is statistically signifi-

cant ($x^2_1 = 7.3$; $p < 0.05$). This leads me to conclude that electrical workers are statistically significantly overrepresented among the leukemia, brain cancer and lymphoma deaths in this utility workers cohort.
2) From the first line of Table 1, I calculated that the case cancers (leukemia, brain cancer and lymphoma) made up 17.2%† of all cancer deaths in men in the cohort. In my experience with similar occupational cohorts, these cancers ordinarily make up about 12% of total cancers. For example, in my California amateur radio operator study§ (Table 1, p.52), there were 700.6 deaths expected in California due to all cancers and 77.6 deaths expected due to leukemia, brain cancer, lymphoma, Hodgkin's disease and multiple myeloma. The expected percentage of case cancers to total cancers was 11.1%.* Without detailed age data for this cohort (not shown in the paper), I cannot calculate a precise expected percentage.
3) In Table 7 of the Sahl study, an internal cohort analysis gave higher estimates of risk than did a case–control analysis for the same cause of death and job title. For example, in retired electricians, an internal cohort analysis gave a leukemia relative risk (RR) of 1.91, while a case–control analysis yielded an odds ratio (OR) of 1.11. Similarly, the RR of lymphoma in retired electricians was 1.65 in an internal cohort analysis vs. an OR of 0.87 in a case–control analysis. Variation in the definition of "exposure" seems to account for these differences, but I find it disconcerting that different methods of analysis of the same data give results that are this different.
4) Although the first word of the title of this paper is "cohort," no standardized mortality ratio (SMR) data are presented using local, California or U.S. death rates to calculate expected deaths. The first author of the paper assures me that these data will be presented in future reports.

For these reasons I feel justified in withholding a final decision on whether this study is negative or positive on the EMF–cancer question until I see more data.

Sincerely,

Samuel Milham Jr., MD, MPH
2318 Gravelly Beach Loop, NW
Olympia, WA 98512

† The lymphoma group actually includes Hodgkin's disease and multiple myeloma in addition to the lymphomas.
‡ [(41 + 28 + 64) / 773] x 100 = 17.2%.
§ *American Journal of Epidemiology, 127,* pp.50-54, 1988.
* (77.6 / 700.6) x 100 = 11.1%.

Milham has identified four issues that cause him to question "the negativity" of our study of cancer mortality among electric utility workers. His comments, however, are based on inappropriate analyses or misinterpretations of our data.

Using data presented in our Methods section, Milham calculates expected versus observed exposure rates. This leads him to conclude that electrical workers are overrepresented among those who died of leukemia, brain cancer and lymphoma. However, his calculations are incorrect because they are based on data we used to assign occupational information for a subset of our cohort rather than the distribution of occupations within the total cohort. We described how there was missing occupational history data. Using a variety of decision rules, we imputed or assigned occupational data for a part of the total occupational history record. For cases and controls where we made occupational history assignments, 21% of the cases had an electrical occupation and 17% of the controls had an electrical occupation. These data do not refer to the relative numbers of electrical workers who are cases and controls. The data in Table 3 provide this information.

Secondly, Milham uses data from Table 1 in an attempt to calculate unadjusted proportional mortality ratios [PMRs]. This analysis highlights one of the limitations of PMR methods. Compared to another occupational cohort, Milham has suggested that our cohort has a proportional excess of leukemias, lymphomas and brain cancers. If it is appropriate to compare these two cohorts and if Milham's suggestion is true, then there are two possible interpretations. Either there was an excess of these cancers in our cohort, or the apparent relative excess is due to a deficit in other types of cancer. Our analysis is based on person-years† at risk for the denominator. Using person-years as a denominator for rate calculations is commonly accepted as the most appropriate method to estimate the proportion exposed in the study population that generated the cases.‡

Milham's third point raises interesting questions. Why are the results different when using different methods of analysis and why does the use of a single summary job title result in higher measures of association compared to analyses that include information from an entire occupational history? First, Milham incorrectly assumes that the different results are from the same data. They actually involve the use of different exposure data. Second, if there was a true risk, then using more complete and accurate job history information, coupled with magnetic fields measured in this work environment, should have provided higher measures of association. The lack of association observed when using stronger epidemiologic methods and more complete exposure data weakens the argument for a strong or moderate effect in this cohort. The specific bias that results from the use of a single occupational title has not been established. We have identified some candidates, some of which we discussed in the original paper.

Milham seems to criticize the use of the term "cohort" in our study title. He implies that without "standardized mortality ratio" analysis, this should not be considered a cohort study. Consulting the *Dictionary of Epidemiology,*§ we found no mention of an SMR analysis being a part of the definition of cohort (or cohort analysis or cohort study). Cohort refers to the well-defined group of people who were followed up over time, as in our study (36,221 people who had worked for SCE for at least one year between 1960 and 1988).

SMR analysis is not the method of choice in the analysis of cohort data.‡ Since we had collected complete demographic, occupational and mortality data on all SCE personnel, it would be inappropriate to use an external reference group in this analysis.‡ The use of an external comparison group introduces bias because of the lack of comparability on other important factors between the exposed and unexposed populations. The SMR can provide useful information when sufficient data are not available to generate a comparison group from within the cohort. Our intention is to publish results from PMR and SMR analyses to help us understand the potential bias introduced when using these analytical methods. In this forthcoming paper, we compare PMR/SMR results to the more appropriate results estimated from cohort person-time and nested case–control analyses.

Finally, it is an oversimplification to characterize our results as "negative." Because of the limited number of cases in our study, our results are compatible with weak EMF effects as well as no effect. We continue to follow up the SCE cohort to obtain more cases, which will eventually yield more precise results.

Sincerely,

Jack D. Sahl, MPH
Southern California Edison Co.
PO Box 800
2244 Walnut Grove Ave.
Rosemead, CA 91770

Michael A. Kelsh, MPH, PhD
EcoAnalysis Inc.
221 E. Matilija St., Suite A
Ojai, CA 93023

Sander Greenland, DrPH
UCLA School of Public Health
10833 Le Conte Ave.
Los Angeles, CA 90024

† In Table 3, the footnote for PY should read "person-years" rather than "proportion-years."
‡ K. Rothman, *Modern Epidemiology,* Boston: Little Brown, 1986.
§ J. Last, Ed., *Dictionary of Epidemiology,* First Edition, New York: Oxford University Press, 1983.

CTIA Drops FDA Role in Cellular Phone Research Program

The Cellular Telecommunications Industry Association (CTIA) is moving ahead with a three-to-five-year, $15 to $25 million research program, but the group has backed away from its plan to have the federal government oversee the studies. "This is going to be a scientific process that will stand on its own merits," said Dr. George Carlo, who has been put in charge of the initiative by CTIA.

At the same time, a senior official at the Food and Drug Administration (FDA)—the federal agency with the primary responsibility for regulating electronic products—has sharply criticized the industry association for presenting an overly rosy picture of cellular phone health risks. In a July 19 letter to CTIA President Thomas Wheeler, Dr. Elizabeth Jacobson, deputy director for science at FDA's Center for Devices and Radiological Health (CDRH), complains that Wheeler's confidence that cellular phones will be proved safe is "unwarranted." She also raises questions about the impartiality of the research initiative and about the way CTIA has portrayed the government's role. (The full text of the letter appears on p.9.)

CTIA has formed a three-person advisory group headed by Carlo, who is chairman of Health and Environmental Sciences Group, a consulting firm based in Washington. The advisory group is currently preparing an assessment of existing studies and a research agenda. Carlo has also set up a nine-member peer-review panel, which will comment on the research agenda and then work with the advisory group to develop requests for proposals (RFPs) for an initial six to eight studies. The RFPs should be issued in November, Carlo said, and funding should be in researchers' hands around the end of the year.

At a CTIA press conference in Washington on July 16, Carlo said that, so far, the advisory group's examination of the literature "has not yielded support for the cancer risk hypothesis." Wheeler, referring to "approximately 100" studies relevant to an evaluation of the safety of cellular phones, said that those analyzed so far "show that there is no relationship between exposure in cellular frequencies and cancer."

The research program was first announced last winter, in reaction to publicity about a lawsuit which alleges that cellular phone radiation caused a Florida woman's brain tumor (see *MWN*, M/J92 and J/F93). At a January 29 press conference, Wheeler announced that CTIA was "asking the federal government to appoint a blue-ribbon panel to review the methodology and findings of this research." No such committee has been formed, however.

Following a meeting between FDA and CTIA officials in mid-August, Dr. Mays Swicord, chief of the radiation biology branch at the CDRH in Rockville, MD, said that CTIA had "taken the offer off the table." FDA officials said that CTIA would not provide the agency with the control it requires to be directly involved in a research program. "We were ready to go ahead with it," Jacobson told *Microwave News*. "I thought it was a missed opportunity."

Carlo maintains that the process that CTIA has established "doesn't do away with the government role" that was initially described by Wheeler. But CTIA spokesman Ron Nessen said that, "Government regulations made it difficult or impossible to do a blue-ribbon panel." Although the FDA proposed a cooperative research agreement, Nessen said, "lawyers on both sides decided this was not a proper arrangement."

Swicord and Jacobson both said that they knew of no objections by FDA lawyers to a cooperative research agreement.

Both Carlo and Nessen emphasized that officials at the FDA, at the National Cancer Institute (NCI) and at other government agencies are being consulted regularly and will review the CTIA research. Carlo is organizing a symposium in Research Triangle Park, NC, on September 30 to discuss the research agenda. As many as 35 leading RF/MW researchers from government and academia are expected to attend, Carlo said.

In her letter to Wheeler, Jacobson wrote that CTIA's statements that the FDA would "review and validate" the research "did not accurately characterize the relationship between CTIA and the FDA." She continued: "It goes without saying that we would review your data."

Jacobson's letter also found fault with CTIA for displaying "an unwarranted confidence that these products will be found to be absolutely safe." She noted that some people "might also wonder how impartial the research can be when its stated goal is 'a determination to reassure consumers.'"

Asked about Jacobson's letter, Nessen said he had not seen it, adding, "I am not familiar with any such criticisms." Wheeler did not respond to repeated calls from *Microwave News*.

Reporters at CTIA's July press conference focused on how the advisory group had come to its conclusion that the existing research provides no cause for concern. Several questions addressed Dr. Stephen Cleary's work showing that brain tumor cells proliferated at an abnormal rate following an exposure to radiofrequency and microwave (RF/MW) radiation (see *MWN*, M/A90). Cleary, of Virginia Commonwealth University in Richmond, used frequencies above and below the 800-900 MHz radiation emitted by cellular phones, but he has said that he would expect to get similar results at cellular frequencies.

"There is a long stretch between being able to measure an effect and being able to identify an adverse process that will lead to cancer," Carlo told the reporters. When pressed to say whether his advisory group rejected Cleary's work, he said: "Those studies have not passed the test of scientific rigor." He added that scientists familiar with Cleary's research had reviewed it for him and had raised "serious questions about the laboratory methods."

Several weeks after the press conference, Carlo told *Microwave News* that "it is not clear-cut that there is something consistent going on" in Cleary's research. But he added, "I've read Cleary's work and it's very important. We may need to see whether or not it is replicable."

Carlo has invited Cleary to the September 30 symposium. Also invited are the other two members of Carlo's advisory group, Dr. Bill Guy, formerly of the University of Washington, Seattle, and Dr. Ian Munro, former director general of the Health Protection Branch of Health and Welfare Canada, along with

FDA to CTIA: There Isn't Enough Data To Gauge Cellular Phone Risks

The following is the full text of a letter, dated July 19, 1993, sent by FDA's Dr. Elizabeth Jacobson to CTIA President Thomas Wheeler.

Dear Mr. Wheeler:

I am writing to let you know that we were concerned about two important aspects of your press conference on July 16 concerning the safety of cellular phones, and to ask that you carefully consider the following comments when you make future statements to the press.

First, both the written press statements and your verbal comments during the conference seemed to display an unwarranted confidence that these products will be found to be absolutely safe. In fact, the unremittingly upbeat tone of the press packet strongly implies that there can be no hazard, leading the reader to wonder why any further research would be needed at all. (Some readers might also wonder how impartial the research can be when its stated goal is "a determination to reassure consumers," and when the research sponsors predict in advance that "we expect the new research to reach the same conclusion, that cellular phones are safe.")

More specifically, your press packet selectively quotes from our Talk Paper of February 4 in order to imply that FDA believes that cellular phones are "safe." ("There is no proof at this point that cellular phones can be harmful.") In fact, the same Talk Paper also states, "There is not enough evidence to know for sure, either way." Our position, as we have stated it before, is this: Although there is no direct evidence linking cellular phones with harmful effects in humans, a few animal studies suggest that such effects could exist. It is simply too soon to assume that cellular phones are perfectly safe, or that they are hazardous—either assumption would be premature. This is precisely why additional research is needed.

We are even more concerned that your press statements did not accurately characterize the relationship between CTIA and the FDA. ("CTIA has asked the Food and Drug Administration to review and validate this new research to ensure its credibility.") It goes without saying that we would review your data and provide comment on it—we view that as part of our job as a regulatory agency. But since it is not yet clear whether we will help to direct the research program, it is premature to state that we will credential the research.

To sum up, Mr. Wheeler, our role as a public health agency is to protect health and safety, not to "reassure consumers." I think it is very important that the public understand where we stand in evaluating the possibility that cellular phones might pose a health risk. I am concerned that your July 16 press conference did not serve that end as well as it should have.

Sincerely yours,

Elizabeth D. Jacobson, PhD
Deputy Director for Science
Center for Devices and Radiological Health
Food and Drug Administration
Rockville, MD

several members of the peer-review panel, according to Carlo.

The members of the peer-review group are: Dr. Patricia Buffler, University of California, Berkeley; Dr. Philip Cole, University of Alabama, Birmingham; Sir Richard Doll, Oxford University, Oxford, U.K.; Dr. Om Gandhi, University of Utah, Salt Lake City; Dr. Saxon Graham, State University of New York, Buffalo; Dr. Don Justesen, VA Medical Center, Kansas City, MO; Dr. Richard Monson, Harvard University School of Public Health (SPH), Boston, MA; Dr. Dimitrios Trichopoulos, Harvard SPH; and Dr. Gary Williams, American Health Foundation, New York City.

Cellular Phone Class Action Suit Dismissed, New Complaint Filed

A judge in Chicago has dismissed a class action lawsuit which alleged that cellular phone manufacturers failed to warn their customers of the possible risks associated with the use of hand-held cellular phones. The attorneys who began the suit filed an amended complaint a week later, however, on behalf of cellular phone users with brain tumors.

The original complaint, filed in early February, shortly after cellular phone safety grabbed headlines nationwide, was a class action on behalf of all users of hand-held cellular phones. Anthony Bass, an attorney with the firm of Holstein, Mack & Klein in Chicago, which filed the suit, declined to say at the time whether any of the named plaintiffs were known to have injuries that might be linked to cellular phone use. "As it stands now, they will be getting tests," he told *Microwave News.* Among other claims, the suit alleged that the manufacturers had breached their implied and express warranties by failing to provide a safe product.

In an August 12 decision, Illinois Circuit Court Judge Edwin Berman rejected this reasoning. He wrote that the FCC and the FDA "have primary jurisdiction over the issues raised in this case" and that state law is preempted by federal law. He also found that the plaintiffs "had not alleged any compensable injury." Berman noted, however, that his decision "does not affect current motions by certain plaintiffs to amend by adding a subclass of persons allegedly physically injured as a result of cellular telephone usage."

The amended complaint, filed on August 20, is on behalf of all cellular telephone users who have diagnosed or undiagnosed brain tumors, according to attorney Gina Fietsam, also with Holstein, Mack & Klein. Two plaintiffs are named "on behalf of all others similarly situated." They are: William Pogue, who began using a cellular phone in November 1991 and was diagnosed with a brain tumor in June 1992; and Matthew Crist, who began using a cellular phone in January 1992 and was diagnosed with a brain tumor in November 1992. They used phones manufactured by NEC America Inc. and Motorola Inc., which are named as the defendants.

Getting a Fix on Maglev, Electric Train and Subway EMFs

A series of new Department of Transportation (DOT) assessments of EMFs from a half-dozen existing electric train systems and an experimental magnetic levitation (maglev) system provides the most comprehensive information yet compiled on the nature and extent of the magnetic fields in passenger coaches, in locomotives and along railroad corridors.

The goal is to create "a data base of EMF characteristics of various transportation technologies," said Dr. Aviva Brecher, EMF research program manager at DOT's Volpe National Transportation Systems Center in Cambridge, MA. Prior to this effort, Brecher added, there was "no information whatsoever," even for the train technologies now in use, making it difficult to compare the EMFs from existing and proposed transportation systems.

The measurements were taken by Electric Research and Management Inc. (ERM), a consulting firm based in State College, PA, under contract to DOT. Altogether, ERM completed five separate measurement reports. These cover: Amtrak and New Jersey Transit trains; Boston's mass transit system; Washington's Metro system; France's high-speed TGV train; and the TransRapid maglev system or TR07, which runs on a test track in Emsland, Germany.

In a summary report, which draws on the findings of the other five, ERM noted that—counter to expectations—the TR07's EMFs are not unique. "The [magnitudes] of the maglev magnetic fields are not only reasonably typical of magnetic fields found on electrified transportation systems, but their frequency characteristics are not greatly different from the frequency characteristics found when looking at...electrified rail technology as a whole," ERM explained. (For a discussion of several other reports assessing the possible health risks posed by maglev and high-speed railroad EMFs, see box on p.11)

Average magnetic field levels near the floor in the passenger compartment of the TR07 were about 100 mG for the frequency range of 2.5 Hz to over 2 kHz, and they dropped off to about 20 mG "at standing head level," according to the maglev measurement report. "Spectrally, the maglev EMFs are richer than those associated with existing electric rail technology," ERM's William Feero told *Microwave News,* "but in magnitude they are not the strongest." Both Brecher and Feero noted, however, that other maglev systems, including a Japanese maglev, for which EMFs have not been measured, use superconducting technology which is very different from that of the TR07 and would have different EMF characteristics.

On an Amtrak coach, average magnetic fields in the 5 Hz to 2.56 kHz frequency range were 134 mG and peak fields reached 628 mG while the train was operating between Washington and New York—a section that is powered by a 25 Hz electrical system. Between New York and New Haven, CT, the average and peak fields were 52 mG and 305 mG, respectively; in this stretch, trains operate on a 60 Hz system. In both cases, the predominant magnetic fields were at the fundamental frequencies of the power systems—25 Hz or 60 Hz—and their harmonics.

The Boston and Washington mass transit systems—which use direct current—generally had much smaller time-varying magnetic fields than the intercity trains, but there was a notable exception. One type of subway car used on the Washington Metro system, the Series 3000, generated an average magnetic field of 317 mG and a peak field of 2,987 mG at the center of the passenger compartment. These fields are due to the control circuitry, which uses a semiconductor system rather than the electromechanical technology used in the other Metro cars. The semiconductor system is an electronic "chopper" that turns the power

Ordering Information

The ERM reports for DOT are being distributed by the National Technical Information Service (NTIS), 5285 Port Royal Rd., Springfield, VA 22161, (800) 553-6847. The titles are: ***Safety of High Speed Magnetic Levitation Transportation Systems: Magnetic Field Testing of the TR07 Maglev Vehicle and System,*** April 1992, Vol.1, PB92224666, 190 pp., Vol.2, PB92224674, 366 pp.; ***Magnetic and Electric Field Testing of the Amtrak Northeast Corridor and New Jersey Transit/North Jersey Coast Line Rail Systems,*** April 1993, Vol.1, PB93219434, 318 pp., Vol.2, PB93219442, 632 pp.; ***Magnetic and Electric Field Testing of the French Train A Grande Vitesse (TGV) Rail Systems,*** May 1993, Vol.1, PB93223071, 220 pp., Vol.2, PB93223089, 422 pp.; ***Magnetic and Electric Field Testing of the Massachusetts Bay Transportation Authority (MBTA) Urban Transit System,*** June 1993, Vol.1, PB93227619, 236 pp., Vol.2, PB93227627, 630 pp.; ***Magnetic and Electric Field Testing of the Washington Metropolitan Area Transit Authority Metrorail System,*** June 1993, Vol.1, 208 pp., Vol.2, 546 pp.; and ***Comparison of Magnetic and Electric Field Tests of Existing and Advanced Rail Systems,*** June 1993, 56 pp. The last two reports are not yet listed by NTIS, but they should be available later this fall. Prices range from $27.00 to $77.00 for paperbacks and from $17.50 to $27.00 for microfiche. A limited number of copies of these reports are available at no cost from: Arne Bang, FRA's manager of special programs, (202) 366-0457, or Dr. Aviva Brecher, (617) 494-3470.

The measurement system used by ERM for this project is described in an EPRI report, ***Measurement of Power System Magnetic Fields by Waveform Capture,*** February 1992, Report No. TR-100061, $200. Contact: Research Reports Center, PO Box 50490, Palo Alto, CA 94303, (415) 965-4081. There is no charge for most reports requested by EPRI member utilities, universities, U.S. government agencies and the media.

See also, J. Hadden et al., ***Safety of High-Speed Guided Ground Transportation Systems: Shared Right-of-Way Safety Issues,*** September 1992, PB93126530, 202 pp., $27.00 for paperback, $12.50 for microfiche. Available from NTIS. Based on the premise that any new high-speed rail or maglev service will have to make use of existing transportation corridors, this report examines numerous mishap scenarios. These range from a power line falling on a high-speed train to a maglev leaving its guideway and crashing into traffic on an interstate. EMF effects are considered as a possible interference problem: the report states that maglev equipment is likely to generate stronger EMFs than conventional railroads, and it concludes that, "Electronic controls on highway vehicles that have been designed to present SAE [Society of Automotive Engineers] standards may not be able to tolerate these fields without a loss of service."

to the traction motors on and off at 273 Hz—273 times a second—the dominant frequency of the EMFs in the cars.

In addition to the assessments of the 25 Hz and 60 Hz systems, the Amtrak Northeast Corridor (NEC) report includes measurements taken on a section where diesel locomotives are still used and on an electric New Jersey Transit train. Amtrak is considering replacing its diesel locomotives with trains similar to those used by New Jersey Transit. The Federal Railroad Administration (FRA) is currently preparing a draft environmental impact statement for the electrification of the NEC between New Haven and Boston. It will include a discussion of EMFs, based in part on ERM's measurement reports, according to

Bioeffects Literature Sifted for Clues on Maglev Health Risks

EPA Report on Broadband EMFs

A new literature review prepared for the Environmental Protection Agency (EPA) addresses the potential hazards of maglev EMFs by focusing on "animal and human exposure to EMFs that have components over a range of frequencies." Fields with pulsed or intermittent characteristics are "of special interest," according to the report by Drs. Arthur Pilla of Mt. Sinai School of Medicine in New York City, Russel Reiter of the University of Texas, San Antonio, and Bary Wilson of the Battelle Pacific Northwest Labs in Richland, WA.

"Although a causal link between exposure to EMFs and increased health risk has not been established for humans, cellular and animal studies offer evidence that such links are at least plausible," the authors write. They do not, however, answer the key question raised by their effort: whether exposures to broadband magnetic fields—they note that they are using "broadband" to distinguish "the complex magnetic fields that are at issue" from "purely sinusoidal" power frequency fields—are more likely to produce adverse health effects. Instead, they conclude that the data "are insufficient to make any clear determination" of which field characteristics are the most important for human health effects.

The report cites a wide range of studies, noting that EMF effects on calcium ions may be frequency-dependent, for example, and that effects on human heart rate can be enhanced when the fields are intermittent. Pineal melatonin secretion—a primary area of research for both Reiter and Wilson—is given particular emphasis. A common characteristic of the cancers that have been associated with EMF exposure, they argue, is that melatonin "appears to be protective" for all except brain tumors. Echoing ERM's conclusions (see story on p.10), the report also states that "there is no evidence that the TR07 maglev vehicle is likely to represent any risk from magnetic field exposure that is greater than that associated with one or more of the presently operating electrically powered rail systems." One scenario they consider—based on the work of Dr. Theodore Litovitz of Catholic University in Washington—actually indicates that the 25 Hz and 60 Hz Amtrak systems could be more likely to produce effects than the maglev with its broadband signals. Litovitz has demonstrated that a coherent signal, such as a pure sinusoidal 60 Hz signal of a particular duration, is necessary to produce certain effects. "Maglev magnetic fields exhibit less coherence in ELF ranges than the AC powered rail systems," the authors point out. (Drawing on Litovitz's research, Honeywell has begun marketing a computer keyboard designed to neutralize the effects of VDT EMFs; see p.18).

The report, ***Broadband Magnetic Fields: Their Possible Role in EMF-Associated Bioeffects,*** was begun in February 1992 at the request of Norbert Hankin of EPA's Office of Radiation and Indoor Air in Washington. The focus on maglev was added later, after ERM's measurements of the fields from the TR07 made it clear that the report could be useful in assessing the safety of maglev EMFs. Prepared for EPA under a contract from DOT, the report will be published by Dr. Aviva Brecher's office at DOT—to avoid delays due to EPA's publication review process, Brecher said. It will be identified as an EPA contractor report, Hankin said, and it will not carry the authors' names, since it has not been through a formal review process.

Literature Reviews

Two other literature reviews addressing the possible effects of maglev and electric rail EMFs are also being published by DOT. Prepared by Information Ventures Inc. in Philadelphia, the two reports contain much overlapping material. The shorter of the two focuses more specifically on adverse health effects. The longer one—which was prepared under an EPA contract but, like the broadband report, is being distributed by DOT—is meant to be a more comprehensive overview of published and unpublished research.

The reports were written by Drs. Robert Goldberg and William Creasey, both of Information Ventures; Dr. Kenneth Foster of the University of Pennsylvania in Philadelphia provided an analysis of ERM's maglev and electric railroad measurement data, which is used in the longer report to compare the magnetic field strengths and frequencies used or identified in the research with those of the maglev and electric rail systems. The authors point out, however, that "these comparisons have limited value in assessing possible human risks from the maglev exposure," since they only reflect one exposure parameter—magnetic flux density. "The magnetic field environment of the TR07 maglev is characterized by large and rapid changes," they explain.

Drafts of both reports were completed in September 1992; they have now been revised to reflect "recent major publications," including the Swedish and Danish epidemiological studies of residential and occupational EMF exposures (see *MWN*, S/O92 and N/D 92) and the CIRRPC report (see *MWN*, N/D92), according to Bruce Kleinstein, president of Information Ventures. The shorter, more narrowly focused report, commissioned directly by DOT, is titled ***Potential Health Effects of Low Frequency Electromagnetic Fields Due to Maglev and Other Electric Rail Systems: A Review of the EMF Bioeffects Research Literature.*** The longer report is titled ***An Overview of Biological Effects and Bioeffects Mechanisms Relevant to Electromagnetic Field (EMF) Exposures Associated With Mass-Transit Electric Rail Systems.*** Both will be available from NTIS later this year, according to Brecher.

EPRI Workshop Proceedings

Meanwhile, EPRI has published a report based on a Chicago seminar it held for utility executives in October 1991 to consider the outlook for the development of maglev and high-speed rail systems. The participants concluded by identifying eight research tasks, including this one: "characterize electromagnetic radiation levels and define acceptable levels, controls, and mitigation measures." An unnamed person noted during a full-group discussion that EMFs could be a "showstopper" for maglev. Other than that, to judge by these proceedings, EMFs virtually were not discussed in the presentations given at this meeting.

Proceedings: High-Speed Rail and Maglev Workshop, Report No. TR-101700, $200, is available from EPRI's Research Reports Center (see ordering information on p.10).

Maglev Safety Workshop

Much of the work compiled in the reports discussed here will be presented in a session on EMF effects at an upcoming workshop on high-speed rail safety that is being cosponsored by the Federal Railroad Administration and the Transportation Research Board (TRB), part of the National Research Council.

The EMF session will be chaired by Janie Blanchard of Bechtel Corp. in San Francisco, who will also give a plenary talk. Other presenters are: EPA's Norbert Hankin and Lynne Gillette, ERM's William Feero, Information Ventures' Dr. Robert Goldberg, DOT's Dr. Aviva Brecher and Dr. Kenneth Groh of Argonne National Laboratory.

The meeting will be held October 18-20 in Itasca, IL, near Chicago's O'Hare Airport. Registration is $150. For more information, contact: Reggie Gillum, TRB, 2101 Constitution Ave., NW, Washington, DC 20418, (202) 334-2382.

Glenn Goulet, also of DOT's Volpe Center, and it should be available in late September.

For each system ERM evaluated, measurements were taken in a passenger coach, in a crew compartment, in a station and along a track right-of-way. "These are extremely complex sources," explained Brecher. Indeed, to collect their data, the ERM technicians used a computerized "waveform capture" system that they developed for the Electric Power Research Institute (EPRI). The reports present much of the data in three-dimensional graphs that show how the strength and frequency of the magnetic fields change over time. Each report is divided into two volumes, the first containing analysis and the second providing appendices with more detailed data.

Injured Microwave Technician To Collect $650,000 in Settlement

In the largest settlement of a microwave radiation injury case, a technician whose eyesight was damaged by an illegal satellite uplink operated by Multicomm Telecommunications Inc. will collect $650,000, according to his attorney, Roy Mason of Mason, Ketterman & Morgan in Baltimore.

Jon Stern of the Washington firm of Katten, Muchin, Zavis & Dombroff, who is representing National Union Fire Insurance Co. of Pittsburgh, said that the settlement between National Union and Keith Angstadt, the injured technician, seems likely, but that it is not yet final.

Angstadt was awarded $2 million in a May 4 judgment against Multicomm. But the company was bankrupt, and there was some question as to whether Angstadt would collect (see *MWN*, M/J93). On June 22, Mason filed a complaint in Baltimore City Circuit Court — which was later transferred to U.S. District Court in Maryland — charging that National Union and Atlantic Mutual Insurance Companies were responsible for the $2 million award because they had sold insurance policies to Multicomm and its parent company, Amway Corp. Amway has been dismissed from any liability, according to Mason.

Mason said that he now intends to collect the remainder of the award from Madison, NJ-based Atlantic Mutual, the primary insurer, which sold Multicomm a $1 million policy. Atlantic Mutual has already filed a "declaratory judgment action," arguing that it should not be held accountable, according to Atlantic Mutual's attorney, Allen Beasley of Breeden, MacMillan & Green in Norfolk, VA.

Angstadt is color-blind following his accidental exposure to 6 GHz microwaves from the transmitter (see *MWN*, N/D92).

Police Radar Health Research

Two new studies have been issued recently on the safety of police traffic radar units:

• Czech researchers have found that weak millimeter waves that simulate emissions from a radar gun can inhibit DNA synthesis in the corneas of mice. In an effort to investigate the possible health risks associated with the use of a new radar unit, the RAMER 7F, a team from the Czech Academy of Sciences and from the Czech Military Academy, both in Brno, exposed hairless mice to 34 GHz radiation with a power density of 20 $\mu W/cm^2$ for two weeks (17 hours per day, five days per week). The experiment was run twice, each time with 12 mice, and a total of 40 controls. Most of the parameters tested showed no changes; two notable exceptions were a statistically significant smaller number of leukocytes (white blood cells) and a significant increase in the mass of the spleens in the exposed mice. Even though the decrease in corneal DNA synthesis is not significant, the researchers commented that this finding is "noteworthy." While they recommended that the use of the RAMER 7F, which is made in the Czech Republic, be allowed, they asked that its instructions "contain a warning of the danger of long-term irradiation to the eyes." See: Dolores Rotkovska, "Evaluation of the Biological Effects of Police Radar RAMER 7F," *Environmental Health Perspectives, 101*, pp.134-136, June 1993.

• Dr. Robert Davis's analysis of a cluster of testicular cancer cases among police officers in Grand Rapids, MI, and in neighboring Wyoming, MI, has been published as a "Brief Communication" in the *American Journal of Industrial Medicine (AJIM)*. At least six cases that could be related to radar use have been identified at the two departments, which have a combined work force of 340 officers (see *MWN*, M/A92). Davis, who is with the University of Washington Medical Center in Seattle, had previously estimated that this was at least triple the expected number, but he now reports that it is a nearly sevenfold excess — a statistically significant finding. Davis and coauthor Dr. F. Kash Mostofi of the Armed Forces Institute of Pathology in Washington note that the analysis was designed to minimize the possibility of finding a cancer excess. To assess the total person-years of exposure for the work force, for example, they looked at 1963 to 1991, even though the first use of radar did not occur until 1970. The officers with testicular cancer were diagnosed between 1979 and 1991. Davis and Mostofi write that the use of radar guns has not been widely studied, concluding that "further research into a possible association with testicular cancer is warranted." See: Robert Davis and F. Kash Mostofi, "Cluster of Testicular Cancer in Police Officers Exposed to Hand-Held Radar," *AJIM, 24*, pp.231-233, 1993.