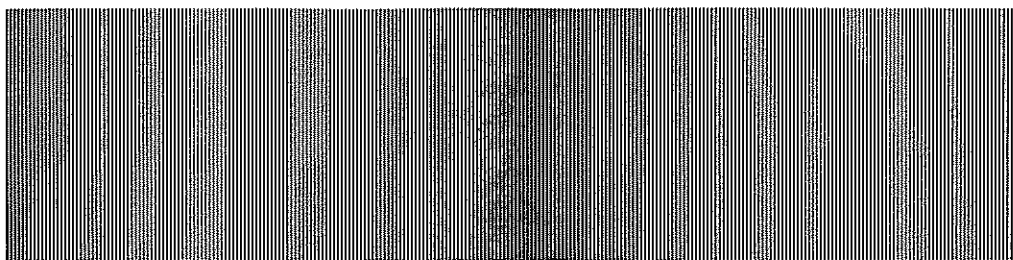


# MICRO WAVE NEWS



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A Report on Non-Ionizing Radiation

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**New Listings**

## Are Brain Tumors Markers for EMF Exposure?

Two new epidemiological studies add to the growing evidence of a link between electromagnetic field (EMF) exposures and brain tumors. In one case, on-the-job EMF exposures were again identified as a risk factor for brain tumors and, in the other, occupational EMF exposures were associated with brain cancer among workers' children.

There are now at least 12 studies pointing to an EMF-brain tumor risk (see table on p.15). "There are far too many positive studies to dismiss an EMF-brain tumor connection," Dr. Samuel Milham, Jr., told *Microwave News*. "It is as important to have a number of studies showing a positive

### **RF/MW Radiation Stimulates Human Brain Tumor Cells**

*A new study shows that brain tumor cells continue to proliferate at an abnormally high rate five days after a two-hour RF/MW exposure. See p.5.*

effect as it is to have one large study," he added. Milham was one of the first researchers to identify brain tumors as an EMF risk factor.

Much of the EMF-cancer research has focused on leukemia as the major risk, but some researchers believe that the brain tumor link is more persuasive. Dr. Nancy Wertheimer said, "I definitely feel the case has always been the most consistent for brain tumors. The focus on leukemia was not warranted by the data."

*(continued on p.14)*

## New Research Funding Proposals Emerge at Congressional Hearing

Support is growing for a significantly larger federal power line research program. At a March 8 congressional hearing, two congressmen said that they will seek funding increases, and a utility spokesman proposed an industry-funded, government-run effort modeled on the New York Power Lines Project (NYPLP).

Rep. Peter Kostmayer (D-PA), who convened the hearing as chairman of the House Interior Subcommittee on General Oversight and Investigation, called for a "doubling or tripling" of the current federal power line electromagnetic field (EMF) research budget of \$3 million. "We are not talking about a lot of money when tens of millions of people may be protected as a result," he said. "The health impact of EMFs may very well be the most overlooked environmental hazard of the decade."

A second congressional proposal surfaced from Rep. Frank Pallone

*(continued on p.7)*

## « Power Line Talk »

All those involved in the **Johns Hopkins University (JHU)** study showing higher cancer rates among NY telephone cable splicers say the work should be continued, yet the JHU team is less than confident that the necessary funding will be available. Following Drs. **Genevieve Matanoski** and **Patrick Breyse**'s announcement at last November's DOE-EPRI review (see *MWN*, N/D89), a peer advisory committee, assembled by EPRI to review the JHU team's original national case-control study, commented on the limitations of the NY incidence study as well. Breyse told us that the committee had concerns that an expansion of the study—even a doubling—would not yield meaningful results because the number of cases would still be too small. The committee—Drs. **Patricia Buffler**, **Philip Cole** and **Carl Shy**—encouraged the JHU team to develop a full research protocol and to seek funding, according to Buffler, who told us that, "We thought it was important that the questions be resolved." EPRI's Dr. **Leonard Sagan** appears to want to settle those issues as well. In the January/February issue of the *EPRI Journal*, he said that, "From the information we have seen...this clearly deserves to be followed up. EPRI intends to pursue possibilities for further research in this area with Dr. Matanoski to clarify the apparent differences in results." Although EPRI asked the JHU team to submit a funding proposal (EPRI did not pay for the NY study), Breyse said that EPRI does not appear to be too "enthusiastic." For the time being, the JHU team is finishing the case-control study before returning to the NY linemen project. "We're committed to expanding the incidence study. Our challenge will be to address the valid criticism of 'small numbers'," he said. The team is also looking around for other funding sources.

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The earth moved on February 28 when *New Yorker* writer **Paul Brodeur** and EPRI's Dr. **Leonard Sagan** went head-to-head in Santa Barbara before the California Municipal Utilities Association—in the middle of Brodeur's remarks, there was an earthquake (5.5 on the Richter scale). "I didn't realize EPRI was so powerful," Brodeur quipped. One observer, **Cyrus Noë**, the editor of *Clearing Up, Northwest Energy Markets*, summed up the debate this way: "Brodeur was appearing before a municipal utility audience that was not particularly sympathetic to his point of view, but despite that home-floor handicap, he beat Dr. Sagan 15 ways from Sunday. Brodeur had passion and outrage, Sagan had colored slides." The EMF issue is hot in Santa Barbara because of an unexplained childhood cancer cluster at the Montecito Union School. Between 1981 and 1988, there were six cases of leukemia and lymphoma among the students—five times the expected rate. Of particular concern is the fact that two 66 kV

power lines are on the perimeter of the school property. In addition, there is an electrical substation close by. The day after the Brodeur-Sagan face-off, **Jack Sahl** of Southern California Edison told the *Santa Barbara News-Press* that, based on his EMF survey, "Montecito looks like just a normal school in terms of [EMFs]." On March 16, the *News-Press* reported that the school board had decided to rope off sections of the school that have strong magnetic fields.

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Brodeur and Sagan would have faced each other again on *Nightline*—if the producers of the ABC-TV News late night show had had their way. An ABC spokeswoman told us that Sagan refused to appear because Brodeur was also scheduled to be interviewed. The *Nightline* show was to air on March 8, the day of the congressional hearing, but had to be delayed until the following night. *Nightline* host **Ted Koppel** interviewed Carnegie Mellon University's Dr. **Granger Morgan** and the New York Power Authority's **James Cunningham**, as well as Brodeur. A transcript is available for \$3.00, prepaid, from: Journal Graphics, Inc., 267 Broadway, New York, NY 10007. Credit card orders: (212) 227-7323. Specify Program #2295.

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Dr. **Jerry Phillips**, whose previous work has demonstrated that 60 Hz EMFs alter growth and membrane properties of human cancer cells, is leaving San Antonio, TX. Formerly with the Cancer Therapy and Research Center, he is joining the research group at the VA Medical Center in Loma Linda, CA, headed by Dr. **Ross Adey**. He and his wife, Dr. **Wendy Haggren**, will be studying the effects of 60 Hz magnetic fields on gene transcription.

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The widely-read *Harvard Medical School Health Letter* took a flippant look at EMF risks in its March issue. The newsletter asked the question, "How real a hazard?" and answered that, "It's impossible to say...." Then it offered the following Rx: "In the meantime, the very cautious may wish to unpack grandma's quilt, turn off the television and curl up with a good novel or seed catalog—or better yet, go out and cultivate the garden." The Harvard analysis appears to have been based on two interviews—with Drs. **Tom Tenforde** and **David Carpenter**. Dr. **Edward Wolpaw**, a member of the NY Power Lines Project scientific advisory group, is a member of the Harvard letter's advisory board.

## Plans for NYPLP-II Continue

The New York State Department of Health (DOH) and the New York Public Service Commission (PSC) are moving forward towards setting up a new research effort on electromagnetic field (EMF) health effects. The PSC is seeking up to \$10 million for the proposed second New York Power Lines Project (NYPLP-II), which would follow up on the findings and recommendations of the original panel report (see *MWN*, J/A87 and N/D88).

"It is important that we reach some definite conclusion on what the hazard is," DOH's Dr. David Carpenter told *Microwave News*. The state cannot conclude that there is a real likelihood of a health risk and then leave it hanging, he said. Carpenter headed the first NYPLP, which sponsored the Savitz epidemiological study as well as a number of other key studies.

Like the original project, NYPLP-II would be directed by an independent panel of experts who would select the research studies to be funded. It would run for five years and would most likely be supported by a consortium of state utilities.

The PSC's Dr. Dan Driscoll has been meeting with state utilities to discuss their funding NYPLP-II. "Everything is still in the planning stage," he said in an interview, adding that he hopes to have something definite "within the next few months." Driscoll noted that the New York Power Authority's March 8 proposal for a \$15-20 million national EMF research program "will certainly have an influence on the next round of discussions" (see p.1).

Driscoll estimated the cost of the project at \$3-10 million, depending on whether the PSC can convince other state commissions, as well as national groups, to participate in a joint EMF research effort—organizations in other countries are also being approached. The project would be limited to \$3 mil-

lion if support comes only from NY utilities, he said.

On December 19, the PSC hosted a workshop on ongoing and future EMF research and the adequacy of its response to the NYPLP panel's recommendations. Five of the original panel members attended. Driscoll said that many of the participants felt that it was "important to do more basic research," particularly on melatonin production, circadian rhythms, gene expression and calcium efflux—areas which have shown "robust effects." The participants also called for further investigation into effects on learning, reaction time and behavior, as well as on neurobiology.

## Power Line Controversy Heats Up in the U.K.

Allegations that government officials are failing to protect the public and workers from power line and other types of electromagnetic fields (EMFs) are being raised in the U.K. The charges were made in the February issue of *Electronics World + Wireless World* (EW+WW), a monthly trade magazine, which devoted extensive coverage to what it called the "Killing Fields."

In an editorial in its March issue, the magazine took the state-owned Central Electricity Generating Board (CEGB) to task for refusing to release the results of an epidemiological study. Dr. Robin Cox, chief medical officer for the CEGB, denied the allegations and said that the results will be submitted for publication, but EW+WW rejected his explanation and argued that Cox is hiding the information. "It seems logical to look for other motives," Editor Frank Ogden wrote.

Ogden suggested that, "Publication would...interfere with the forthcoming privatization [of CEGB] scheduled for the end of the year" (see *MWN*, M/A88). If CEGB's preliminary findings support a link between EMFs and cancer, Ogden noted, there will be public calls for compensation and mitigation.

The contributors to the "Killing Fields" special issue were: Alasdair Philips of Electronics and Computing for Peace; Simon Best, a coauthor of the 1989 book, *Electromagnetic Man*; and Roger Coghill, a private consultant who has claimed an association between sudden infant death syndrome (SIDS) and EMF exposure (see *MWN*, M/A89).

Philips questioned the safety of the National Radiological Protection Board's (NRPB) extremely low frequency (ELF) exposure guideline of 2 mT (20 G or 20,000 mG). He charged that, in its references, the NRPB had "deliberately excluded" most of the reports showing possible dangers from low-level, non-thermal EMFs. Indeed, the literature review promised in 1988 has still not been published.

The special report coincided with an editorial in the February 1990 issue of the *Journal of the Royal Society of Medicine* by CEGB's Cox, who concluded, on the basis of completed research, that "fields from power frequency systems do not have any significant health effects for the general public."

### NY Proposes 200 mG Limit

The New York Public Service Commission (PSC) has proposed an interim magnetic field limit of 200 mG for new transmission line right-of-ways (ROWs). The announcement came on March 28, as *Microwave News* went to press.

The limit is twice as lenient as the 100 mG recommendation made by a PSC task force in 1988. Dr. Dan Driscoll, who chairs the task force, told *Microwave News* that the 200 mG limit was determined on the basis of technical design considerations—not health concerns.

To obtain a copy of the proposed standard, contact: John J. Kelliher, Secretary, New York PSC, 3 Empire State Plaza, Albany, NY 12223, (518) 474-2500. For more on development of the standard, see *MWN*, M/A88 and M/J88.

The editorial sharply criticized epidemiological studies of residential ELF exposures by Dr. Nancy Wertheimer and Ed Leeper and by Dr. David Savitz. "An objective assessment of the epidemiological evidence must...lead one to the conclusion that it is weak and unconvincing," Cox wrote. He argued that the public has been swayed by "quasi-scientific work."

Cox noted, however, that confirmation of Savitz's findings would suggest "a significant public health problem because of the ubiquity of the fields" at the 2 mG level found by Savitz to be associated with an increased risk of childhood cancer.

At the NRPB, Assistant Director J.A. Dennis has taken a more moderate position. In a letter that appeared in the April issue of *EW+WW*, Dennis stated that there is "a growing literature" associating EMF exposures and cancer. Responding to charges that the NRPB had discounted the epidemiological data without cause, Dennis cited inconsistencies in the data. "Given the uncertainty about the reality of the risk and the considerable uncertainties in its quantification, it would be premature to specify limits based on the possibilities for long-term effects on health," he wrote. "Nevertheless, there is obviously a case for avoiding unnecessary exposures and reducing exposure levels where this can be done easily." He also advocated further research.

The stirring within the U.K. electronics community is having an impact in the U.S. An editorial in the March 15 issue

### Censorship at the BBC

The British Broadcasting Corp. (BBC) was pressured into dropping an interview with the CEEB's Dr. Robin Cox, in which he refused to give assurances that there were no health risks associated with living next to power lines, according to a report by Tim Kelsey in the April 1 issue of *The Independent on Sunday*, published in London.

Cox was interviewed for a segment aired on the March 22 edition of the BBC television show, *Nature*. At the last minute, a second interview with Cox was substituted over the objections of the BBC producers.

The National Grid Co., which owns and operates the power lines in the U.K., asked the BBC to delete the first interview, because, as a spokesman for the National Grid told the *Independent*, Cox "had been ambushed" and the company was seeking to protect Cox's reputation—not to save the industry from embarrassment.

of *Electronics Design News* summarized *EW+WW*'s major findings and joined the call for more research. "Clearly, it's time to carefully examine our standards for exposure to electromagnetic radiation in the [ELF] portion of the spectrum," the editorial stated.

## New from EPRI

The following publications from the Electric Power Research Institute (EPRI) range in subject matter from power line (AC and DC) bioeffects to electromagnetic interference (EMI). Copies (except for the *EPRI Journal* and the Delavan proceedings) are available, prepaid, from: Research Reports Center, PO Box 50490, Palo Alto, CA 94303, (415) 965-4081.

- "Pursuing the Science of EMF," *EPRI Journal*, January/February 1990. In a cover story on EMFs, EPRI reviews its growing research efforts, with an emphasis on laboratory, exposure assessment and epidemiological studies. The 14-page article includes a special section on the Matanoski telephone linemen studies (see *MWN*, N/D89 and p.2) For more information, contact: Editor-in-Chief, *EPRI Journal*, PO Box 10412, Palo Alto, CA 94303.

- *Extremely Low Frequency Electric and Magnetic Fields and Cancer: A Literature Review*, EN-6674, \$32.50, December 1989. This report is a revision of a background paper prepared for EPRI's July 1988 workshop on EMFs and cancer research held in Carmel, CA. It is supplemented by abstracts of the papers presented at the workshop. Among the topics covered are epidemiological and laboratory studies, as well as dosimetric and engineering factors. The review was prepared

by Drs. Robert Goldberg and William Creasey of Information Ventures, Inc. in Philadelphia, PA, the firm that used to publish the BENER reports. An electronic version of this data base will be available soon.

- *Pilot Study of Residential Power Frequency Magnetic Fields*, EL-6509, Final Report, \$40.00, September 1989. Luciano Zaffanella of General Electric found that the largest contributors to residential magnetic fields are transmission and distribution lines, grounding system currents and unusual wiring configurations. He concluded that magnetic fields from distribution line net currents and residential grounding system currents "could not be predicted solely by visual inspection of distribution line characteristics" and that "despite a correlation between [Wertheimer-Leeper] wiring code and magnetic field, the code would misclassify a large portion of residences...." These observations were based on measurements at 53 residences. EPRI is expanding the study to include 1,000 homes around the country.

- *Identification of Ions Near HVDC Transmission Lines*, EN-6391, Final Report, \$25.00, May 1989. F.L. Eisele of the Georgia Institute of Technology in Atlanta offers evidence that the types of ions generated near high-voltage DC (HVDC) transmission lines are chemically similar to those found in the natural environment. His results suggest that the

lifetimes of both positive and negative ions are important determinants of the ion spectra found near HVDC lines.

- **Current Studies of Possible Health Effects of Exposure to Power Frequency Electric and Magnetic Fields**, EN.3009.11.89R, \$200.00 (free to members), November 1989. This 30-piece slide show on EMFs, which includes a script for speakers, describes EPRI's current research program. Also available free of charge (\$20.00 for each additional copy) are two related publications, *Electric and Magnetic Fields: Human Health Studies*, EN.3010.11.89, November 1989; and *Electric and Magnetic Field Fundamentals*, EN.3012.9.89, September 1989.

- **Mutual Design: Overhead Transmission Lines and Railroad Facilities; Susceptibility Program**, EL-6462-M, Final Report, \$32.50, July 1989. This is the latest report on possible EMI from power lines to railroad signaling systems (see also *MWN*, S83 and Mr84). A team led by M.J. Frazier of the Science Applications International Corp. in Hoffman Estates, IL, developed a method of quantifying the EMI threat with a laboratory track simulator. The lab test "agreed very closely with

field results, verifying the accuracy of the simulator." The Association of American Railroads cosponsored the study with EPRI.

- **EMDEX System Manuals, Volume 1: User's Manual and Volume 2: Technical Reference Manual**, EN-6518, Interim Reports, \$25.00 and \$32.50, respectively, October 1989. Volume 1 provides instructions for using the EMDEX measurement system, an ELF dosimeter; Volume 2 presents detailed descriptions of the hardware and software. The reports were prepared by Enertech Consultants in Campbell, CA.

- **Proceedings of the EPRI Utility Seminar on Power Frequency Electric and Magnetic Field: Laboratory Research**, held September 27-29, 1989, in Delavan, WI. Among the topics addressed were cancer and cell physiology—as well as health risk research in general. Copies are available for \$50.00 (EPRI members, public agencies, nonprofits and universities) or \$250.00 (all others) from: Robert S. Banks Associates, Inc., 825 Washington Ave., SE, Suite 104, Minneapolis, MN 55414, (612) 623-4646. Note: Only a limited number of copies are available.

## HIGHLIGHTS

### ***RF/MW Stimulates & Suppresses Human Brain Tumor Cells***

Five days after a two-hour exposure to radiofrequency and microwave (RF/MW) radiation, human brain tumor cells continued to proliferate at an abnormally high rate. At higher levels, however, the radiation suppressed cell growth. Drs. Stephen Cleary, Li-Ming Liu and Randall Merchant of Virginia Commonwealth University in Richmond observed similar results one and three days following exposure.

The researchers found highly statistically significant enhancement at specific absorption rates (SARs) of 5 or 25 W/Kg. At higher SARs, cell growth was suppressed. Essentially the same effects were obtained for exposures to unmodulated 27 MHz and 2450 MHz radiation.

In a paper published in the January 1990 issue of *Radiation Research* (121, pp.38-45), Cleary and coworkers report that RF/MW radiation had pronounced effects on the DNA and RNA synthesis of glioma cells, as measured by the incorporation of thymidine and uridine—genetic building blocks.

The cells were kept at a constant temperature during exposure, allowing the authors to conclude that the "effects were not induced indirectly by heating."

In a second paper, scheduled to appear later this year in *Bioelectromagnetics*, the team will report parallel effects when lymphocytes—white blood cells—were exposed under the same conditions. These cells were untransformed.

These results have important implications: on the one hand, RF/MW radiation may promote cancer and, on the other

hand, the radiation could be harnessed to treat malignancies. "If you stimulate transformed cells, you can enhance their potential growth," Cleary told *Microwave News*. "But on the upside, if you can retard them, there is a potential for great benefit." For example, Cleary envisions the day when blood cells may be circulated out of the body, as in dialysis, and exposed to RF/MW radiation to suppress proliferation of cancer cells.

In the paper, the researchers say that their findings are "significant since [they] suggest the possibility of cumulative effects of RF radiation when exposure occurs at intervals on the order of five days or less." The combined findings suggest a "general cellular response" to RF/MW radiation. The team hypothesizes that the effects may be explained by a shifting of cell cycles.

The results pose many questions. For instance: Are there effects at SARs below 5 W/Kg? Does the stimulation continue beyond five days after exposure? What are the effects of multiple, intermittent exposures? Would different effects be observed *in vivo* where heat would not be dissipated as effectively as *in vitro*?

Cleary is having difficulty securing funds for further research. "It's very frustrating," he said. "Without a new grant, we will be unable to investigate the effects of cumulative and multiple exposures or to determine mechanisms."

### New World Health Organization Report on NIER

The World Health Organization's (WHO) Regional Office for Europe has published a second edition of its report on *Non-Ionizing Radiation Protection*. The 346-page volume covers the spectrum from extremely low frequency (ELF) fields to ultraviolet radiation, and includes a section on regulation and enforcement.

Since the first report was issued in 1982 (see *MWN*, My83), "...much new research has been performed and experience gained in NIER protection, especially in the areas of radiofrequency [RF] radiation and electric and magnetic fields [EMFs]," according to the WHO.

In the chapter on RF radiation effects, Drs. P.A. Czerski, Joe Elder, Kjell Hansson Mild, Asher Sheppard and Maria Stuchly conclude that limiting occupational and general population exposures by "voluntary or mandatory standards is desirable," and note that the IRPA RF exposure guidelines reflect the "emerging international consensus." They recommend that future research look at frequencies below 10 MHz, "where few data exist."

Drs. Larry Anderson and William Kaune, who prepared the chapter on ELF fields, conclude that current research suggests that EMFs are "environmental agents of relatively low potential hazard to biological systems," and that, "Human data from epidemiological studies, including reported effects on cancer promotion, congenital malformations, reproductive performance and general health, though somewhat suggestive of adverse health effects, are not conclusive."

*Non-Ionizing Radiation Protection*, Second Edition, (WHO Regional Publications, European Series No.25, 1989; Order No.1310025), edited by Michael Suess and Deirdre Benwell-Morison, is available for \$34.40 from: WHO Publications Center USA, 49 Sheridan Ave., Albany, NY 12210; or for 43 Sw. Fr. from: WHO Distribution and Sales, 1211 Geneva 27, Switzerland.

### Electronic Devices-Avionics EMI Report Available

The Radio Technical Commission for Aeronautics (RTCA) has released its report on electromagnetic interference (EMI) to aircraft communications and navigation systems from portable electronic devices. The RTCA recommends that the use of all such devices be prohibited during takeoffs and landings.

Overall, the RTCA concludes that the risk of interference is "small" but recommends that the Federal Aviation Administration develop rules which "specify the conditions under which portable electronic devices may be operated on an aircraft." The RTCA also recommends that the Federal Commu-

### New Microwave Meters from Narda and Holaday

The two leading microwave (MW) meter manufacturers have introduced new monitoring devices.

#### Constant Surveillance Monitor

Loral Microwave-Narda is marketing a meter called SMARTS that sounds an alarm and flashes lights whenever field levels exceed 1 mW/cm<sup>2</sup>. The device is the first of its kind, making it possible to warn of possible over-exposure at all times. Previously, high field levels could be detected only while measurements were being taken with a hand-held meter. The monitor operates at 2 to 18 GHz.

The model 8820 SMARTS (Surface Mounted Automatic Radiation Threshold Sensor) is similar in concept to a household smoke detector and is designed for sites where exposure is a constant concern, such as areas next to high-power MW systems and satellite uplink stations.

The model 8820 SMARTS is available for \$2,500.00 in the U.S. from: Loral Microwave-Narda, 435 Moreland Rd., Hauppauge, NY 11788, (516) 231-1700.

#### Low-Cost Oven Meter

Holaday Industries is selling a new inexpensive microwave oven meter. The model HI-1801 is calibrated from 0 to 10 mW/cm<sup>2</sup>. A "check" function responds to very low leakage levels to assure that the meter is working.

Model HI-1801 is available at the introductory price of \$289.00 (for a limited time) from: Holaday Industries, Inc., 14825 Martin Dr., Eden Prairie, MN 55344, (612) 934-4920.

nications Commission create a new class of carry-on devices and set frequency and amplitude limits for their radiation emissions.

The RTCA report was essentially completed in late 1988 and its findings were made available to *Microwave News* at that time (see *MWN*, N/D88).

The two-volume report, *Potential Interference to Aircraft Electronic Equipment From Devices Carried Aboard* (RTCA/DO-199), was prepared by Special Committee 156, chaired by Frank White. Volume I contains the findings and recommendations, as well as data collection and analysis. Volume II includes supporting reference materials. Both are available from: RTCA, One McPherson Square, 1425 K St., NW, Suite 500, Washington, DC 20005, (202) 682-0266. The cost is \$32.00 per volume in the U.S., Canada and Mexico (\$40.00 elsewhere), plus \$4.00 shipping and handling (\$8.00 elsewhere). Prepayment is required.

(D-NJ), who announced that he will introduce legislation to increase federal research and public information.

Almost all of the hearing witnesses backed a significantly larger federal power line research program; the only opposition came from the Department of Energy (DOE) and the Environmental Protection Agency (EPA)—ironically, the two agencies historically most involved in EMF research.

Kostmayer appeared visibly frustrated by DOE and EPA officials. Both agencies "are resistant to recognizing the potential seriousness of the problem we're facing," he said in an interview with *Microwave News*. DOE is "indifferent, almost cavalier," he added.

Robert San Martin, a deputy assistant secretary of energy, described the department's EMF research as "rational and reasonably satisfactory at this time."

EPA's Richard Guimond, head of the Office of Radiation Programs, testified that, "We don't advocate modifying our role at this time." Guimond said that EPA currently is completing a cancer assessment on EMFs and is preparing a handbook on EMFs similar to EPA's widely distributed radon handbook.

The hearing attracted an overflow audience but only one subcommittee member other than Kostmayer.

### **Industry Initiative**

James Cunningham, a senior vice president at the New York Power Authority (NYPA) who appeared on behalf of the Large Public Power Council (LPPC), proposed that the electric utility industry voluntarily provide \$15-20 million for a federally supervised research program. The proposal seemed to surprise other industry officials, who opposed it.

Dr. Leonard Sagan of the Electric Power Research Institute (EPRI) called instead for more federal funding. "The federal government has failed in its responsibility," Sagan charged. It should "engage in a far greater research program than formerly." In contrast to most other witnesses, Sagan characterized EMF risks as "entirely hypothetical and uncertain." He cautioned, however, that confirmation of health effects would involve "potentially great costs to the nation."

Kostmayer told *Microwave News* that he would consider introducing legislation to provide tax credits or other incentives to encourage utilities to contribute. If LPPC's proposal is not viable, he will support legislation to increase federal funding. "If we can get the industry to pay, that's great," he said. "If not, we're going to have to find the federal funds."

Dr. Granger Morgan, of Carnegie Mellon University and a coauthor of the 1989 Office of Technology Assessment (OTA) report recommending "prudent avoidance" (see *MWN*, J/A89), also identified a "strong need for a stronger and more consistent federal role." Morgan warned that, "If there are health consequences, there will not be time to learn how to respond." Morgan specifically cautioned that the power line issue may be "driven" by liability. "Spending the next 10-15 years litigating is not in anybody's best interest," he said.

### **Prudent Avoidance?**

Prudent avoidance means different things to different people. Rep. Peter Kostmayer asked several witnesses whether they have changed their lifestyles out of concern about EMF exposures. Here's what they said:

Carnegie-Mellon's Dr. Granger Morgan reported that he had moved his son's bed across the room away from the household electricity point of entry, gotten rid of his electric blankets and moved clocks away from beds. Chris Dodge of the Library of Congress took less extensive measures, putting away his electric blanket "except during the last cold snap." OTA's Karen Larsen has not yet been sufficiently concerned. "One of these days I'll get measurements," she reported.

In response to the perennial question, "Given the option between buying a house along a transmission line right-of-way (ROW) and buying an identical house at the same price at another location further from the ROW, which would you buy?" Morgan said he would choose to live further from the line. He first protested that there are numerous risk factors that might influence his decision but then conceded that, "If it's a cost-free choice, obviously I'd live in the house that doesn't have an external source."

Diane Allen, the TV reporter, said that she had her utility bury the main entry line to her house. Philadelphia Electric (PE) had found "very high" magnetic field levels at the point of entry, she said. Subsequent readings found fields just 10% of what they had been. In addition, Allen threw away her electric blanket and moved the clock radios from her children's bedstands.

PE's Charles Boeggeman was the only utility official asked about residential EMF levels. He said that his company has responded to more than 100 requests for measurements over the past three years. There is no set protocol and the readings are "not exhaustive," he explained. Boeggeman said that if a field of 30 mG is found in a location, for example, "we may tell the resident to consider moving the baby's crib."

In testimony submitted after the hearing, the Electromagnetic Energy Policy Alliance, a trade association, called prudent avoidance "illogical and inappropriate" and opposed it altogether.

### **DOE, EPA Programs Critiqued**

Dr. David Carpenter, who supervised the NYPLP, sharply criticized federal efforts in general and DOE's program in particular, calling it a "disaster." "The fault lies with the federal government, that they have not taken the lead," Carpenter testified. There is a need for more money and better management, he added.



Carpenter told the subcommittee that DOE does not use a legitimate peer-review process in awarding grants, and charged that "higher ups" at the department want it that way. When he served on a DOE review panel, he said, the panel held just one business meeting, at which just one proposal was reviewed and rejected. In contrast, DOE hosted three cocktail parties for the panelists, he said.

Carpenter also criticized EPA's "very poor" track record, but added that he has "high regard" for many EPA staffers. He advocated concentrating power line research at the National Institutes of Health, despite a recent controversy at the National Cancer Institute over officials who provided paid testimony on behalf of utilities involved in legal challenges to transmission line sitings.

### Credibility Questions

The objectivity of EPRI-supported research was a theme that dominated the hearing, since EPRI now spends twice as much each year as the government. "Public concerns over the credibility of health research funded by electric utilities that have an interest in the final outcome are not easily dismissed," Kostmayer said. Cunningham countered by arguing that although he recognizes "there is a perception of bias...we deny this bias." Sagan was more direct in defending EPRI research: "The industry deserves credit rather than criticism."

Most of the testimony echoed Kostmayer's concern, however. TV reporter Diane Allen, who aired a five-part news series on power line EMFs last fall, told the subcommittee that EPRI-supported scientists "were the least forthcoming and the most vague about their research." Allen told of one unidentified scientist who was "reluctant" to discuss possible EMF health hazards on-camera but who told her off-camera, "I sure wouldn't sleep under an electric blanket." Sagan expressed surprise about this incident and said that he had "never before heard that investigators are constrained."

Others also expressed doubts about relying primarily on utility-sponsored research. Karen Larsen, senior analyst for the OTA study, testified that she is aware of some concern among EPRI-funded researchers "that positive findings may mean that funding won't be renewed."

Carpenter raised questions about members of EPRI's advisory panels, who he said are "paid rather well." EPRI has "logically chosen individuals with certain philosophies," he told the subcommittee. "Any time money changes hands it has the potential to influence one's opinions."

Sagan reacted angrily to the charges. "Everybody pays their consultants," he said. "I think [EPRI] is objective." Morgan, who is heading a large risk study for EPRI, also defended its research program. "One should not fault this industry for taking initiatives," he said.

Kostmayer asked several experts to respond to Sagan's statement that EMF risks "remain entirely hypothetical and uncertain." Morgan, Dodge and Carpenter all disagreed with Sagan.

### ROW Limits Proposed

Rep. Frank Pallone (D-NJ) plans to sponsor a second piece of legislation, which would set a field strength standard at an as-yet-undetermined level along transmission line right-of-ways (ROWs) for new lines.

Dr. Robert Becker, the author of *Cross Currents*, supported the ROW limit concept. In prepared testimony, Becker stated that there are sufficient data to set a "permissible dose rate." Basing his recommendation on studies showing an association between cancer occurrence and EMF exposure at levels above 3 mG, Becker called for a maximum acceptable level of 1 mG in all dwellings, schools and public buildings near transmission lines, substations and distribution lines. He also recommended that that limit be time-averaged for utility workers to an integrated dose of 8 mG per day.

Pallone attributed his involvement to constituents in and around Middletown, NJ (in his district), who have been opposing construction of a 234 kV transmission line along an electric railroad ROW (see *MWN*, J/A89).

### Invited Witnesses

(in alphabetical order)

Diane Allen, Anchor-Reporter, WCAU-TV, Philadelphia, PA; Dr. Robert Becker, Author of *The Body Electric* (1985) and *Cross Currents* (1990), testimony submitted; Charles Boeggeman, Electrical Engineer, Philadelphia Electric Company; Dr. David Carpenter, Dean, School of Public Health, State University of New York, Albany; James Cunningham, Senior Vice President, New York Power Authority, testifying on behalf of the Large Public Power Council (LPPC); John Deason, Office of Environmental Affairs, Department of the Interior (DOI); Frank De Vito, Township Committee Member, Middletown, NJ; Christopher Dodge, Congressional Research Service; Richard Gulmond, Director, Office of Radiation Programs, Environmental Protection Agency (EPA); Karen Larsen, Senior Analyst, Office of Technology Assessment (OTA); Jack Lee, Jr., Environmental Health Specialist, Borneville Power Authority (BPA); Dr. M. Granger Morgan, Department of Engineering and Public Policy, Carnegie Mellon University; Rep. Frank Pallone, Democrat, 3rd District of New Jersey; Dr. Leonard Sagan, Program Manager, Radiation Studies Program, Electric Power Research Institute (EPRI); Robert San Martin, Deputy Assistant Secretary for Renewable Energy, Department of Energy (DOE); Reglna Siferski, Chairman, Newtown Township, PA, Environmental Committee on Radiation.

### Excerpts of Prepared Remarks

(in order of appearance)

*Rep. Peter Kostmayer, Opening Remarks:* The research results now strongly suggest an association between exposure to EMFs at power line frequencies and certain types of cancer, central nervous system disorders, reproductive abnormalities and other health problems. The health impact of EMFs may very well be the most overlooked



environmental hazard of the decade, and while it is the responsibility of scientists to assess the risk, it is the duty of Congress to determine whether the American public is being adequately informed about and protected from known and suspected hazards.

...The electric power industry, which will be represented here today by EPRI, estimates that it is spending \$6 million on EMF research, or about 40% of all funding worldwide. Industry-sponsored research can make important contributions to our knowledge. But public concerns over the credibility of health research funded by electric utilities that have an interest in the final outcome are not easily dismissed....

The federal government's record on power line health effects research is disappointing. While the DOE is budgeting \$3 million for research, a DOE advisory committee recently suggested that DOE should be doing more in the important area of epidemiology. EPA in recent years has closed down its EMF research efforts. Given both the research evidence and the potential exposure of tens of millions of Americans to power line EMFs, I find this simply unacceptable....

**Rep. Frank Pallone:** I would like to briefly explain the concepts of two companion bills that I will soon introduce.

The first bill would mandate a type of "prudent avoidance" by requiring that all newly constructed electric utility transmission power lines meet maximum field strength standards at the edge of the power line's right-of-way (ROW). I welcome input from any interested party as to what that standard should be.

The second bill is a research and development bill and has a public education component, as well. This bill would require a cooperative effort between DOE and EPA to do a human exposure assessment related to EMF. In addition to this assessment, I want an epidemiological study of the health effects of EMF at different levels of exposure. Another research component that is needed involves studies to improve the design of electric power transmission lines and the means by which power is conveyed to buildings where the power is used.

Finally, this bill would require EPA to develop and implement a comprehensive public information campaign to provide up-to-date materials about the health effects of exposure to electromagnetic fields and any practical means for the public to practice "prudent avoidance."

**Frank De Vito:** Last year, our governing body learned of a proposal by Jersey Central Power and Light Company to construct a 234 kV transmission line on 144-ft. towers over a 9.8-mile stretch running through Middletown and five other towns in our area. The line was to be erected along the NJ Transit Railroad ROW. The line would be directly abutting more than 230 homes as well as a number of grammar schools and nursery schools in our area.

As the scope of the project became more clear, the Township Committee retained counsel to fight the proposal....Middletown Township has committed well over \$100,000 of its own tax dollars to fight this 234 kV intrusion into our community. We will continue to fight and hire experts and go to court.

**Regina Siberski:** I recognize a need for extending research outside the controlled laboratory into actual fields of life. Total frequency identification is necessary. Serious consideration to man-made radiation from a *multitude of sources* must be prime in this hearing. Power lines must not be singled out; other users share in this serious concern. The entire frequency spectrum must be considered as it exists in the environment today.

I respectfully request that you consider the information gathered at this hearing and continue in the interest by first raising the priority level of this issue in the EPA. Do not abandon or set this important...issue aside.

**Diane Allen:** For a period of six months in 1989, I researched the effects that EMFs have on our everyday lives....

Research is the key...but in this case, it is also the problem....Most of the research money being spent comes from utilities. This worries many people, including me. Allowing utilities to examine and solve this problem for your constituents is tantamount to the tobacco companies being the primary researchers into hazards of cigarette smoking....I'm sorry to report to you today that in my preparation for the series, the doctors and scientists under contract to [EPRI] were the least forthcoming and the most vague about their research.

I am not saying that there is a big cover-up going on out there; rather in the endless chase for research dollars, one has to question the credibility, or objectivity, of those who might lack the will to bite the hand that feeds them.

**Christopher Dodge:** We are confronted with an ambiguous situation today in that, traditionally, the Soviet/Eastern European bioelectromagnetics (BEM) research community has been more concerned about the health effects of power frequency fields than its U.S./Western European counterpart. Today, in testimony at this hearing, it is evident that the U.S. and Western Europe [are] voicing greater concern about the carcinogenic effects...than [their] Soviet/Eastern European counterpart....

Clearly, public concern about this issue has been escalating over the past decade. I have been told by some BEM researchers that a majority of the BEM community at large now believes that power frequency EMFs are biologically active, whereas ten years ago, a minority shared that belief. It would now seem appropriate for the BEM research community to establish what, if any, risk there is to the general public or various occupational cohorts from chronic exposure to power frequency fields.

**Dr. Granger Morgan:** • Adopt a more pro-active approach [on policy-focused research needs]. • Avoid paying too much attention to high-voltage transmission lines. If we have a problem, distribution lines, building wiring and appliances may be the primary sources. • Start research on options for exposure avoidance and control. It is not clear that fields present a risk, but if it becomes clear they do, pressure will be high for *rapid* risk management action. Responding *then* in an efficient and cost-effective fashion will require careful engineering and economic studies *now*. • Undertake studies of non-adversarial policy options to avoid a storm of liability litigation against appliance manufacturers, utilities and others. • Undertake studies of how responsible companies can take exposure avoidance actions without legal consequences.

**Robert San Martin:** During the last ten years, some 100 challenges to construction of new transmission lines have been filed based on EMF issues. Most of these cases were resolved only after lengthy hearings. Of the six most important transmission links currently under consideration, four include EMFs among the reasons for delay....

Federally funded research in this area has been perceived as more objective than similar research funded by the electric utilities. Therefore, continued federal effort is important, not only to assure the public health and safety, but to assure the ability to strengthen the nation's electric network through new transmission and distribution facilities.

**Richard Guimond:** From EPA's inception, non-ionizing electromagnetic radiation has been an important element of the agency's radiation protection activities....

Presently, we are reviewing the current scientific literature relating to carcinogenicity and are writing a document that describes and critically evaluates this data....After internal technical reviews are

## New ELF Funding Proposals Before Congress

completed, I anticipate that the report will be ready for review by EPA's Science Advisory Board in the summer. Based on the conclusions of this report, the agency will determine to what extent we should revise our research and operational programs....

**Dr. Leonard Sagan:** EPRI believes that the existing federal research program, primarily at DOE, has played a pioneering role in providing new insights in EMF biology. Despite the efforts of DOE and EPRI, the health risks of EMF exposure remain entirely hypothetical and uncertain.

Given the background of major uncertainty and of public concerns, demands may be heard for mitigation. Currently we do not know whether mitigation of fields is appropriate and, if appropriate, what parameters of exposure should be mitigated. In this environment, the proper role for the federal government is to engage in a far greater research program than formerly.... We have, for many years, encouraged this larger federal research effort.... We believe that such an expanded federal program should be comprehensive, including epidemiological studies as well as laboratory studies. The objective of this program should be ultimately to produce a risk estimate, if indeed, a risk exists.

Finally, EPRI considers it important that close communication be established and maintained among agencies involved in funding EMF research.

**Dr. David Carpenter:** I believe that a federal research program focused on health hazards from EMFs is essential.... Federal programs to date have been grossly inadequate, both in terms of level of effort and in terms of administration of those funds made available. At present, the major federal program, administered by DOE, has refused to apply peer review and has generally supported mediocre research. DOE is widely perceived as having too close ties to utilities to be credible in any case. NIH, which is the agency that should be involved in health-related research, has not addressed this issue appropriately. Several employees of the National Cancer Institute have been permitted to accept large sums of money for testimony on behalf of utility companies just at the time when the evidence of a correlation between magnetic field exposure and cancer incidence is becoming very strong. EPA is also an appropriate agency for administration of such a research program, but has suffered from erratic funds and interest. The result of this lack of competent and focused federal activity is that almost all research of significance other than that funded by NY State is supported by EPRI, the organization with the greatest interest in *not* finding health hazards from EMFs....

Unfortunately, our present state of knowledge is insufficient to allow reasonable exposure standards to be set. While states have an interest in this issue, the lead should be federal. To date, unfortunately, the federal government has abdicated that role to small programs such as ours in NY and to partisan organizations such as EPRI.

**Jack Lee:** Today, EMF is considered as a decision factor in the planning of all of our new transmission projects.... We try to avoid increasing long-term public exposure to EMF if practical alternatives exist....

BPA staff are presently developing methods for implementing the interim guidance. Basically, in NEPA documents for proposed lines, staff conduct an EMF exposure assessment. This consists of comparing EMF levels expected from the new line with levels from existing lines in alternative routes. The number of nearby homes in each route is also determined. If it appears that exposures to homes near the edge of the ROW could increase, measures are investigated for reducing EMF levels. One approach that has successfully been used is reconfiguration of the wires of multi-circuit lines. This can result in significant reduction of field strength through phase cancellation. At

other times, fields can be reduced by adjusting the location of the lines on a multiline corridor, or by adjusting the location of the ROW. Each project is evaluated on a case-by-case basis in terms of identifying practical mitigation alternatives....

**James Cunningham:** I appreciate this opportunity to represent LPPC, which consists of 17 of the nation's largest public power systems.... We recognize that there is a perceived bias in research funded by the utility industry. We deny this bias, but we cannot ignore the perception.

As one solution, we believe EPRI should allow appropriate federal agencies...to participate fully in the review of its scientific projects and in selection of research to be supported by the institute. This would continue EPRI's vital role in EMF research while helping to refute doubts as to its credibility.

Another approach would be for states to continue their own independent research. But, absent better coordination than has been evident thus far, there is a real danger that limited research dollars will be wasted on duplicative efforts or on studies that are not sufficiently well designed.

We are therefore proposing today a model for a national EMF research program to permit the broadest possible collection, analysis and dissemination of data. This program would be structured along the lines of the NY Power Lines Project.... The research would focus on a limited number of areas of greatest scientific and public concern and would be strongly coordinated with work by EPRI, DOE and others to avoid duplication, except where justified on scientific grounds.

Our proposal's major features include: An independent board of seven to nine national and state public officials would administer the program. The board ideally would include leaders from the fields of public health, science and utility regulation.... The board would select a scientific steering committee, which would include an EPRI representative.... Funding, approximately \$15 million to \$20 million, would come primarily from a onetime voluntary assessment on electric utilities throughout the nation. States currently pursuing independent programs of this type would be asked to consider adding their funds as well....

The program we propose will take time to complete—probably 5-8 years. But that is all the more reason to move quickly now....

**Dr. Robert Becker:** In the power frequency region, the data available provide not only a hazard assessment but evidence for a permissible dose rate as well. The studies of Wertheimer and Leeper, Tomenius, Savitz and, most recently, Matanoski all relate a significant increase in cancer incidence with either occupational or residential exposure to power frequency magnetic fields over 3 mG. Additional studies in this area, if they are appropriately performed, appear unlikely to materially add to this body of evidence.

I therefore propose that the following regulatory action be taken at the national level. All new construction, transmission lines, substations, distribution lines, etc., be required to produce no more than a maximum of 1 mG in any adjacent dwelling, school or public building. That exposure rates for utility workers, without protective clothing, be limited to a total dose of 1 mG x 8 hours per day. And that the combined utility companies be required to produce a plan of action to bring existing installations of the same type into compliance with these requirements by the year 2000....

I urge the reactivation of the EPA program with adequate funding for its expansion to include the entire spectrum of use of EM energy. ...In view of the politicization of the issue and the emotional content that the citizenry is presently displaying, I recommend that at least one, and possibly more, ad hoc external review panels be set up to monitor progress and ensure the adequacy of projects and reports.

# CONFERENCES

## New Listings

May 8-9: **Microwave Food Safety: A Special Seminar on Microwaveable Food and Packaging Issues and How & Why Microwave Heating Is Different**, Registry Hotel, Minneapolis, MN. Contact: International Microwave Power Institute, 13542 Union Village Circle, Clifton, VA 22024, (703) 830-5588.

May 21-25: **7th Biennial Nuclear EMP Meeting**, University of New Mexico, Albuquerque, NM. Contact: C.W. Jones, Metatech Corp., 2309 Renard Place, SE, Suite 401, Albuquerque, NM 87106.

May 23-25: **44th Annual Frequency Control Symposium**, Stouffer Harborplace Hotel, Baltimore, MD. Contact: Dr. Raymond Filler, U.S. Army Electronics Technology and Devices Lab, Attn: SLCET-EQ, Fort Monmouth, NJ 07703, (201) 544-2467.

June 19-22: **NIST EMI Metrology Short Course**, Vail, CO. Contact: Jose Cruz, NIST, MS 360, 325 Broadway, Boulder, CO 80303, (303) 497-3763.

June 30-July 4: **International Right of Way Association (IRWA) International Seminar**, Denver, CO. Contact: IRWA, 13650 S. Gramercy Place, Gardena, CA 90249, (213) 538-0233.

August 15-17: **Symposium on Antenna Technology and Applied Electromagnetics**, University of Manitoba, Winnipeg, Canada. Contact: L. Shafai, Dept. of Electrical & Computer Engineering, University of Manitoba, Winnipeg, Manitoba R3T 2N2, Canada, (204) 474-9615.

August 18-24: **9th Annual Scientific Meeting and Exhibition of the Society of Magnetic Resonance in Medicine (SMRM)**, Hilton Hotel, New York, NY. Contact: SMRM, 1918 University Ave., Suite 3C, Berkeley, CA 94704, (415) 841-1899.

September 6-7: **40th Annual Fall Broadcast Symposium**, Hotel Washington, Washington, DC. Contact: Dr. Philip Rubin, Rubin, Bednarek Associates, 1667 K St., NW, Washington, DC 20006.

September 9-14: **25th Congress Ampere on Magnetic Resonance**, Stuttgart, F.R.G. Contact: Dr. J.U. von Schütz, Physikalisches Institut, Universität Stuttgart, Pfaffenwaldring 57, D-7000 Stuttgart 80, F.R.G., (0711) 685-5273.

October 15-16: **22nd Annual North American Power Symposium**, Auburn University, Auburn, AL. Contact: Dr. Morteza Daneshdoost, Electrical Engineering Dept., Southern Illinois University at Carbondale, Carbondale, IL 62901, (618) 536-2364.

# UPDATES

## COMPATIBILITY & INTERFERENCE

**Hearing Aid Interference...**Some hearing aids may be picking up more than sound waves. A team of British doctors reported the case of a 96-year-old woman whose hallucinations were at least in part the result of RFI. The woman was initially treated with drugs. When she was hospitalized two years later, however, her hearing aid, which was resting on a bedside table, was heard broadcasting a local radio station. "We think that this happens more often than is reported," Drs. D. King and M.G.M. Malster of Liverpool Hospital and Dr. D.N. Brooks of Withington Hospital in Manchester concluded. They recommend that, "Hearing aids should be checked regularly, especially when patients complain of 'auditory hallucinations.'" They explain that many hearing aids designed to switch from a microphone to a telecoil function suffer switch corrosion, producing a connection that allows broadcast signals to be picked up and amplified. Comparable interference problems have been reported for inner-ear cochlear implants (see *MWN*, S/O85). (For more on the general problem of EMI to medical devices, see *MWN*, N/D85.) "Auditory Hallucinations' From a Hearing Aid?" appeared in the *British Medical Journal*, 299, p.1141, November 4, 1989.

## EMP

**Assorted Notes...**In a new paper, "EMP Simulators and Public Safety: An Analysis," Drs. D.C. Agouridis and Clay Eastery of the Oak Ridge National Lab in Tennessee conclude that EMFs "produced by EMPs and EMP simulators can result in a variety of conditions, which in certain circumstances could be hazardous and/or exceed the ANSI guideline." The analysis appeared in *Bioelectromagnetics*, 10, pp.355-360, 1989. (See also *MWN*, J/A88.)...The Defense Nuclear Agency (DNA) is seeking help in determining the susceptibility of

strategic submarines to interference from high-altitude EMPs. The DNA wants to characterize EMP underwater environments and to identify and design hardening requirements and verification tests. The successful contractor will need a "secret" security clearance. The DNA notice appeared in the October 24 *Commerce Business Daily*....The USAF has awarded a \$123 million contract to the Westinghouse Electronic Systems Group for the development of EMP-resistant radios which operate in the ELF and VLF frequency bands, according to the November 6 *Defense News*....In the U.K., Electronics & Computing for Peace (ECP) has published a 34-page booklet on "Nuclear Electromagnetic Pulse." Written by Tim Williams, an electronics design engineer and founding member of ECP, the booklet gives an overview of the potential effects of EMP on power grids, communications technology and military systems. Williams concludes that EMP protection measures are "not feasible except for highly critical systems where cost is not a consideration." Copies of the booklet are available for £2.30 from: Louis Barman, ECP, 89 Acre Rd., Kingston-on-Thames, Surrey, U.K.

## INTERNATIONAL

**VOA Transmitter in Israel...**Plans to build an 8,000 kW Voice of America (VOA) transmitter in Israel's Arava Valley have sparked concerns among environmentalists, local farmers and the Israeli Air Force. The proposed transmission station, which would beam broadcasts to Central Asia, Africa and Europe, is so powerful that the Air Force plans to move training flights of their F-16 fighters for fear that the transmitter will interfere with the planes' guidance systems. Local farmers are less than eager to live where the Air Force fears to fly. They have called attention to the potentially harmful health effects of RF radiation from the transmitter, which would be approximately eight times as powerful as the De-

## UPDATES

Iano, CA, VOA transmitter currently being investigated in connection with the McFarland cancer cluster (see *MWN*, J/F88, J/A88, M/A89 and J/F90). Environmentalists, who say that the station will not only be an eyesore in the heretofore pristine valley but will also disrupt the migration of birds across the Negev desert, have called for the cancellation of the project in testimony before the U.S. Congress. The VOA and the Israeli Government have dismissed these concerns and construction will begin soon, barring a last-minute reversal.

### MEETINGS

**Mechanisms at BEMS...**Dr. Stephen Cleary of Virginia Commonwealth University is organizing a symposium on mechanisms of interaction for the June 10-14 *Annual Meeting of the Bioelectromagnetics Society* in San Antonio, TX. The session will feature Dr. V.V. Lednev of the U.S.S.R.'s Institute for Biological Physics in Puschino, who will discuss his model of interaction which has been the focus of much interest recently, and Dr. W. Grundler of the Institute for Radiation Biophysics in Munich, F.R.G., on the effect of millimeter waves on yeast growth. Cleary and Dr. Henry Lai of the University of Washington will speak on non-thermal effects and MIT's Dr. James Weaver will review his and Dr. Dean Astumian's widely publicized model of very weak electric field effects (see *MWN*, J/F90).

### PEOPLE

**Ken Klein**, who recently retired from DOE, has joined Energetics, Inc., a consulting firm based in Washington, DC. ...**Laurie Geissinger** is once again working on EMFs for Seattle City Light. Last year, she left the utility, where she was the EMF coordinator, to become a water resource planner. Now, Geissinger has opened her own consulting firm, *Environmental Planning and Research Associates*, on Vashon Island....**Michael Rau** has been promoted to senior vice president of science and technology at the National Association of Broadcasters. Rau, an engineer, earned a law degree in 1988.

### RESOURCES

**Solitons...**A number of researchers have long believed that solitons, waves that do not dissipate as they propagate, may hold the key to explaining energy transfer—and therefore EMF interactions—in cells (see *MWN*, Mr83). Dr. Alwyn Scott of the University of Arizona, Tucson, clarifies these concepts in "The Solitary Wave," which appears in the March/April 1990 issue of *The Sciences*. For example: "Related to the mystery of protein energetics is the question of how the double helix of the DNA molecule comes apart during protein synthesis....The physical scientist...can point to no clear source of energy for the unzipping and re-zipping....If a soliton could pass up and down the double helix...it could easily provide enough energy to zip and unzip genetic material

almost indefinitely." The bimonthly magazine is published by the New York Academy of Sciences.

**Biomagnetism...**Andrew Skolnick calls biomagnetic imaging "one of the most exciting areas in radiology." His article, "Biomagnetometry Provides a New Compass for Exploring the Brain and Heart," appeared in the February 2, 1990 issue of the *Journal of the American Medical Association*....Three papers and a commentary appearing recently in *Nature* took a look at magnetic bacteria: "Magnetic Iron-Sulphur Crystals from a Magnetotactic Microorganism," by Brazil's Dr. Marcos Farina and his colleagues, appeared in the January 18 issue (343, pp.256-58); it was followed by "Biomagnetization of Ferrimagnetic Greigite ( $\text{Fe}_3\text{S}_4$ ) and Iron Pyrite ( $\text{FeS}_2$ ) in a Magnetotactic Bacterium," by a team led by Dr. Stephen Mann of the University of Bath, U.K. (pp.258-61). Dr. R.J.P. Williams of the University of Oxford, U.K., prepared a "News & Views" column to accompany the papers (pp.213-14). One week earlier, in the January 11 issue, a group headed by Dr. Jörg Fassbinder of the University of Munich, F.R.G., published "Occurrence of Magnetic Bacteria in Soil" (343, pp.161-63).

### STANDARDS

**CISPR on Spark-Ignited Engines...**CISPR has updated its radiated limits and test methods for spark-ignited engines. This is the third edition of *Limits and Methods of Measurement of Radio Interference Characteristics of Vehicles, Motor Boats and Spark-Ignited Engine-Driven Devices* (CISPR 12, 1990), which is designed to protect AM and FM radio and TV reception inside buildings. The first edition was published in 1975, the second edition in 1978. The 77-page document is written in both English and French. A copy is available for \$75.00, prepaid, from: International Sales Department, American National Standards Institute, 1430 Broadway, New York, NY 10018, (212) 354-3300.

### VDTs

**Danish Pregnancy Study...**The preliminary results of a new Danish epidemiological study indicate no serious reproductive risks associated with VDT work regardless of the number of hours spent at the terminal. They do show a relationship between stress and adverse pregnancy outcomes, however. The results were released on the steps of Århus City Hall on October 16, 1989. A translation of the Danish release was made available to *Microwave News* by IBM Corp. Drs. Lars Brandt and Claus Vinter Nielsen of Århus University's Institute of Social Medicine and Department of Occupational Medicine did find a "tendency for higher-stress VDT work to entail a risk of adverse pregnancy outcomes in contrast to lower-stress VDT work." It is not clear how the effects of stress were distinguished from those of VDTs. Brandt and Nielsen also identified an increased risk of a specific developmental

defect in the offspring of VDT workers. They did not specify the type of defect and dismissed its importance. Details of the study, which was based on questionnaires completed by 6,212 women encompassing 6,541 pregnancies, are still sketchy. Dr. Brandt told *Microwave News* that the full results will be made available when the paper is accepted for publication.

ETC...

**Zap Trap...** Pests don't like weak pulsed magnetic fields. Two Iowa inventors recently patented a device that employs household electrical current to repel rodents, the March 3 *New York Times* reports. "This does not kill rats or mice. It just affects their nervous systems so that they don't want to be in the field," according to Gary Lutz, one of the inventors.

## FROM THE FIELD

### Magnetic Fields from Ceiling Cable Heating Systems

*Louise Young, the author of Power over People (Oxford University Press, 1973), sent us the following letter. She also sent a copy to Dr. Nancy Wertheimer, who shared her reply with us.*

To the Editor:

One source of magnetic field exposure which has received very little attention is electric heating by cables installed in the ceiling. Like a giant electric blanket, this form of heating produces 60 Hz magnetic fields and the occupants of these buildings are exposed intermittently throughout the winter season.

I live in an electrically heated apartment building and I have taken many readings with my digital milligauss meter. I find that in cold weather the heating is on approximately half the time, exposing me to fields that vary from 3.5 to 12 mG, depending on the position within each room. It is not just the perimeter of the room that is bathed in high magnetic fields, as Nancy Wertheimer's studies suggest, but the main area of the room itself. The highest fields appear to be somewhat randomly located, an effect caused no doubt by the particular wiring configuration in our ceiling and its relationship to the wiring in the ceiling of the apartment below. The intensity of the fields increases near the ceiling and down toward the floor, rising to 20 mG in some locations.

Having discovered this, I measured the fields in a number of other electrically heated buildings, including one single-family home. In most of these locations the fields were in the same range as those cited above. The exception was the single-family home, where the fields were two or three times higher. The strongest fields occurred in the second floor bedrooms, varying in the range of 15 to 25 mG, and as high as 35 mG down near the floor. Holding the meter up near the ceiling, the readings went off the scale (>200 mG).

It is very disturbing to think that countless families here in the United States and throughout the world may be chronically exposed to magnetic fields that are many times the level that has been found to be associated with childhood leukemia and—to a lesser degree—many forms of adult cancer and birth defects. Electric heating is favored in apartment buildings and office buildings as well as in single-family homes. Of course, some of the occupants of these buildings also use electric blankets and video display terminals (VDTs). It occurs to me that one of the reasons for the clustering of cases of spontaneous abortion among VDT operators, for example, may be a double exposure where computers are used in office buildings that are electrically heated.

I think it is imperative that this hazard be given immediate attention. Epidemiological studies should be undertaken to determine the incidence of cancer and birth defects among people living or working in electrically heated environments. Electric blankets can be turned off without serious loss of comfort but electric heating cannot. Attention should be paid to redesigning this type of wiring so magnetic fields are not produced. Conversion to DC current is a reason-

able alternative. But what about existing systems? Would it be possible to retrofit them in a way that would significantly reduce the hazard? Much more research is needed to answer these questions.

Sincerely,  
Louise B. Young  
Wilmette, IL

To the Editor:

I am surprised to learn that ceiling cable electric heat is used in Illinois. It is most commonly found where electric power is (or has been) cheap, and the weather is moderate. Ed Leeper and I studied this source of magnetic field (and electric field) exposure in Oregon, but only relative to fetal loss.\*

We do not contend that only the perimeter of the room will have excess magnetic field exposure—although we have traced the room-wide field to the method of stringing the wires: The ordinary back-and-forth pattern produces a good deal of cancellation of fields everywhere but at the edges, and ends up giving a field much like you would get from a wire running around the perimeter of the room. A few feet away from the ceiling this field is fairly uniform within the room.†

I do not, however, feel that the ceiling cable heat will produce a cancer risk in direct proportion to the increase in maximum field exposure. The magnetic field will only be present sporadically—when the heat is on. Also, we do not know that the effects go up linearly with intensity of exposure, especially not as intensities exceed the range (up to about 4-5 mG) explored by the epidemiological studies. I would not be at all surprised to find that at high but sporadic exposure levels the effects might be quite different from those found at moderate, more continuous exposure.

One point is clear: We need more research to find out the answers to some of these questions. My hope is that answers will now start coming from many different directions, allowing us eventually to understand better what we are studying, and how to study it.

Sincerely,  
Nancy Wertheimer, PhD  
Boulder, CO

\* Nancy Wertheimer and Ed Leeper, "Fetal Loss Associated with Two Seasonal Sources of Electromagnetic Field Exposure," *American Journal of Epidemiology*, 129, pp.220-224, 1989. See also *MWN*, N/D88.

† In a paper presented at the IEEE's 9th Annual Conference of the Engineering in Medicine and Biology Society in 1987, Finland's Dr. Jukka Juutilainen and coworkers at the University of Kuopio reported that the measured magnetic fields in homes with ceiling cable heat were largely below 1 mG. We have not yet discussed with them possible reasons for the apparent differences between their and our results.

Brain cancer is on the rise in the U.S. Drs. Devra Lee Davis of the National Research Council and Joel Schwartz of the Environmental Protection Agency have reported that mortality from brain cancer among older white men and women approximately tripled between 1968 and 1983 (*Lancet*, i, pp.633-636, 1988).

At least eight EMF-brain tumor studies are under way around the world (see *MWN*, N/D89).

### **Astrocytomas Most Likely Subtype**

Dr. Susan Preston-Martin and coworkers at the University of Southern California (USC) School of Medicine in Los Angeles found a significantly elevated risk of gliomas—particularly astrocytomas—among men who were likely to be exposed to EMFs on the job. For astrocytomas, the most common subtype of gliomas, the odds ratio (OR) was 4.3 and was statistically significant among those exposed for more than five years. No similar increase was observed for meningiomas.

The USC findings parallel those of a 1987 study by Dr. Terry Thomas and coworkers (see *MWN*, S/O87 and p.15). In a telephone interview, Preston-Martin said, "If there is a relationship, it looks as if astrocytomas may be the connection."

Milham, an epidemiologist with the Washington state Department of Health, agreed. "It makes perfect biological sense that an excess of only certain types of brain tumors would be observed," he said.

Preston-Martin and coworkers interviewed 272 men, ages 25-69, from Los Angeles County with primary brain tumors first diagnosed between 1980 and 1984. Among the other risk factors considered were on-the-job chemical exposures, smoking, alcohol and serious head traumas. Their paper, a general survey of brain tumor risk factors, was published in the November 1, 1989 issue of *Cancer Research*. A detailed analysis of the EMF findings was submitted for publication in February, Preston-Martin told *Microwave News*.

Preston-Martin is also working on a study of childhood brain tumors and residential EMF exposures, which is being funded by the state of California (see *MWN*, J/A89).

### **Parental Occupational Exposures**

Drs. Christine Cole Johnson and Margaret Spitz found that children whose fathers were employed in jobs involving EMF exposures had a 60% increased risk of brain and central nervous system tumors, which was statistically significant. Among children of electricians, the risk was three-and-a-half times the expected rate.

Four of the seven children of electricians in the study were diagnosed with tumors in the brain stem.

"It is conceivable that [EMF] exposures could play a role in the genesis of mutations or tumors, although convincing evidence has yet to be reported," Johnson and Spitz concluded in their paper. Johnson is with the Henry Ford Hospital in Detroit, MI, and Spitz is with the M.D. Anderson Cancer Center at the University of Texas in Houston.

"If there is an effect from EMFs, it has to be on the germ cell," Spitz told *Microwave News*. She added that studies at the molecular level are needed to confirm this. Johnson was not available for an interview.

Johnson and Spitz studied children in Texas who died between 1964 and 1980 and whose fathers were employed in industries involving EMF exposures at the time of the children's births.

The researchers caution that some agent other than EMFs—e.g., chemicals—might have been at work. For example, they found an OR of 10.0 for construction electricians, who "work largely with unenergized wiring," but who also are exposed to numerous solvents. Their paper appeared in the *International Journal of Epidemiology*.

Johnson and Spitz previously reported an association between childhood neuroblastoma risks and paternal occupational EMF exposures (see *MWN*, J/A85). At that time, they speculated that magnetic fields might function as weak cancer promoters.

### **The Evidence Grows**

In the June 1988 issue of the *American Journal of Industrial Medicine*, Dr. Marjorie Speers and coworkers reported an increased risk of brain tumors among Texas workers in jobs associated with EMF exposures. For utility workers, the risk was 13 times the expected rate.

In an editorial accompanying Speers's report, Dr. Baruch Modan of the Tel Aviv University Medical School in Israel concluded that, with respect to brain tumors, "EM energy, which is with us to stay, must be considered an environmental hazard and dealt with accordingly, until proven otherwise."

Prior to the Speers study, Drs. Milham, Thomas and Ruey Lin had each found increased brain tumor risks associated with occupational EMF exposures. Dr. David Savitz's study of childhood cancer showed a doubling of brain tumor risk among children living near high-current power lines.

Last year, two unpublished studies provided further evidence of the brain tumor-EMF association. Savitz and co-worker Dr. Dana Loomis found that electrical workers had significantly elevated mortality from brain tumors. "These results are certainly more suggestive of an effect on brain cancer as compared to leukemia," Savitz said (see *MWN*, N/D89). And last November, Drs. Genevieve Matanoski and Patrick Breyse reported that telephone cable splicers had a 70% increased risk for brain tumors (see *MWN*, N/D89).

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## EMF Brain<sup>†</sup> Tumor Studies

Ruey S. Lin et al., "Occupational Exposure to Electromagnetic Fields and the Occurrence of Brain Tumors: An Analysis of Possible Associations," *Journal of Occupational Medicine*, 27, pp.413-419, June 1985 (see MWN, O84 and J/A85).

Samuel Milham, Jr., "Mortality in Workers Exposed to Electromagnetic Fields," *Environmental Health Perspectives*, 62, pp.297-300, 1985 (see MWN, M/A86).

Terry L. Thomas et al., "Brain Tumor Mortality Risk Among Men with Electrical and Electronics Jobs: A Case-Control Study," *Journal of the National Cancer Institute*, 79, pp.233-238, August 1987 (see MWN, S/O87).

Marjorie A. Speers, James G. Dobbins and Van S. Miller, "Occupational Exposures and Brain Cancer Mortality: A Preliminary Study of East Texas Residents," *American Journal of Industrial Medicine*, 13, pp.629-638, 1988 (see MWN, J/A88).

David A. Savitz et al., "Case-Control Study of Childhood Cancer and Exposure to 60 Hz Magnetic Fields," *American Journal of Epidemiology*, 128, pp.21-38, 1988 (see MWN, N/D86 and J/A87).

D.P. Loomis and D.A. Savitz, "Brain Cancer and Leukemia Mortality Among Electrical Workers," Abstract, *American Journal of Epidemiology*, 130, p.814, 1989 (see MWN, N/D89).

Christine Cole Johnson and Margaret R. Spitz, "Childhood Nervous System Tumours: An Assessment of Risk Associated with Paternal Occupations Involving Use, Repair or Manufacture of Electrical and Electronic Equipment," *International Journal of Epidemiology*, 18, pp.756-762, 1989 (see p.1).

Susan Preston-Martin, Wendy Mack and Brian E. Henderson, "Risk Factors for Gliomas and Meningiomas in Males in Los Angeles County," *Cancer Research*, 49, pp.6137-6143, November 1, 1989 (see p.1). Detailed paper in press.

Genevieve Matanoski, Elizabeth Elliott and Patrick Breyse, "Cancer Incidence in New York Telephone Workers," presented at the *Annual Department of Energy-Electric Power Research Institute Contractors Review*, November 15, 1989, Portland, OR (see MWN, N/D89).

Risk increased with EMF exposure; odds ratio (OR) = 2.15 for "definite EM exposure." The average age at death was significantly lower among workers with presumed high exposures.

Among electricians, there was a 55% increased risk of brain tumors ( $p < 0.01$ ); for all occupations with EMF exposure, the increased risk was 23% ( $p < 0.05$ ).

Astrocytic tumor risks increased with duration of electrical employment; among those employed for less than five years, relative risk (RR) = 3.3; for employment of 5-19 years, RR = 7.6; and for 20 years or more, RR = 10.4 ( $p < 0.05$ ).

Workers in jobs associated with EMF exposure had an OR = 3.94. Among utilities workers alone, OR = 13.10 (statistically significant). As in Lin's study, there was a "linear relationship between the probability of exposure to [EMFs] and brain cancer."

Children living near high-current power lines had an OR = 2.04 (statistically significant), compared to those living near low-current lines (based on wire codes).

Electrical and electronic technicians had the highest risk of brain tumors (OR = 3.1), followed by electric power repairers and installers (OR = 2.4). For all electrical workers, OR = 1.5 (statistically significant).

Children of fathers who were electricians had a significantly elevated risk of nervous system tumors (OR = 3.5,  $p < 0.05$ ); four of the seven children of electricians had tumors in the brain stem. Overall risk for those whose fathers worked in jobs with potential EMF exposures was 1.6 ( $p < 0.07$ ).

Occupational EMF exposures were associated with higher risks of gliomas. The link was strongest with astrocytomas for exposures of > 5 years—a statistically significant OR = 4.3. Risk increased with years on the job (for trend,  $p = 0.008$ ).

New York Telephone cable splicers had an elevated risk of brain tumors; OR = 1.79 For all cancers, OR = 1.8 (statistically significant). Average exposure levels were 4.3 mG.

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<sup>†</sup> Three other studies link EMF exposure to central nervous system (CNS) cancer. Brain tumors are by far the most prevalent type of CNS cancer. See Nancy Wertheimer and Ed Leeper, "Electrical Wiring Configurations and Childhood Cancer," *American Journal of Epidemiology*, 109, pp.273-284, 1979; Lennart Tomenius, "50 Hz Electromagnetic Environment and the Incidence of Childhood Tumors in Stockholm County," *Bioelectromagnetics*, 7, pp.191-207, 1986; Nancy Wertheimer and Ed Leeper, "Magnetic Field Exposure Related to Cancer Subtypes," *Annals of the New York Academy of Sciences*, 502, pp.43-53, July 2, 1987 (relates to adult cancer).



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