COMMENTARY

How *Not* To Revise the 1982 ANSI RF/MW Radiation Limits

This summer, the Bioelectromagnetics Society (BEMS) will present its highest honor, the D'Arsonval Award, to Dr. Ross Adey for his work on weak electromagnetic fields and their non-thermal effects. Although Adey won the support of the leaders of the society, not everyone is pleased. Dr. Eleanor Adair, for one, has resigned from the BEMS Awards Committee, charging that the decision will be an "embarrassment" to the society and that "his selection both demeans the award and denigrates the society." Many members of BEMS are astonished by Adair's charges.

Adair's work is on thermal physiology and she may have doubts about the existence of electromagnetic effects that have nothing to do with heating—she favored giving the award to Dr. Sol Michaelson, a loyal member of the thermalist school.

All this would only be a bad case of sour grapes if it did not raise serious questions about Adair's new role as co-chair, with Dr. Om Gandhi, of the subcommittee which is revising the 1982 American National Standards Institute (ANSI) limits for exposure to radiofrequency and microwave (RF/MW) radiation. In the absence of federal standards from the Environmental Protection Agency (EPA) or from the Occupational Safety and Health Administration, the ANSI limits have become the *de facto* U.S. standards and millions of Americans depend on them for protection at home and on the job.

The Adair-Gandhi subcommittee has now endorsed using a specific absorption rate (SAR) of 4 W/Kg as the threshold for ill effects in the revised standard—the same level as was used in 1982. In a February 2 letter to Dave Janes of the EPA, Adair wrote that she and Gandhi "agree that no further evaluation of the literature database is required to confirm the 4 W/Kg criterion."

The 4 W/Kg threshold was derived from studies by the U.S. Navy on behavioral disruption, according to Adair. On hearing this, EPA's Dr. Joe Elder responded that 4 W/Kg can *kill* an animal; he pointed out that SARs of 3.6 W/Kg are known to kill rats in a little over two hours. It is true that fur-bearing animals have different thermal regulatory systems than humans, but Elder also noted that rhesus monkeys experience "marked hyperthermia" at SARs of greater than 3.4 W/Kg and cannot tolerate SARs of more than 5.1 W/Kg for more than ninety minutes. He urged the subcommittee to "accept the dose rate of 4 W/Kg as the adverse effect level based on lethality in laboratory animals."

To be sure, ANSI builds in a safety factor—the 1982 exposure limits are based on an SAR of 0.4 W/Kg. But if 4 W/Kg can kill, what can the radiation do in more subtle ways and how much protection is warranted?

By retaining a 4 W/Kg limit, Adair and Gandhi appear to be disregarding a whole body of work that has appeared since 1982. The research is on both thermal and non-thermal effects and it indicates that 0.4 W/Kg is not protective.

In addition, there is no evidence that the subcommittee has ever discussed the potential RF/MW cancer risk—the subject of an ongoing EPA investigation.

With respect to thermal effects, EPA's Dr. Christopher Gordon has argued that when scaling from one species to another, differences in surface area are more important than differences in weight. According to Gordon's calculations, safety levels would have to be tightened by a factor of nearly ten to protect against the greater thermal insult.

When we reported Gordon's thesis two years ago, we quoted Elder as saying, "I expect there will be a lot of discussion of Gordon's paper in the bioelectromagnetics community" (see *MWN*, J/A87). This has not happened. That Adair has rejected Gordon's position is her prerogative, but she should nevertheless be encouraging a debate, not stifling one.

On the non-thermal front, the findings of Henry Kues of the Johns Hopkins University Applied Physics Lab and Jack Monahan of the Food and Drug Administration have serious implications: they have shown that pulsed microwaves can cause leakage in the blood-eye barrier of a monkey at an SAR as low as 2.6 W/Kg. When the eye is treated with glaucoma medicine the threshold is lowered to 0.26 W/Kg. How ANSI takes into account such synergy will be important to the more than two million Americans who use glaucoma drugs (see *MWN*, S/O86, J/A87 and J/A88).

The fact that the latest Kues-Monahan findings have not yet been published—the manuscript is in final editing—is immaterial. Both researchers are respected members of BEMS and they have presented a steady stream of results at the annual meetings. There is no doubt that the work is germane to health standards, so why is ANSI ignoring it?

Adair fears that giving the D'Arsonval Award to Adey will reflect badly on BEMS. This is nonsense. A much more important concern is how Adair's and Gandhi's actions on the ANSI standard will reflect on the bioelectromagnetics community if they fail to apply available knowledge to protect public and occupational health.

The "Commentary" column will be a regular feature in Microwave News. *We invite our readers to write to us with their opinions.*

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CONFERENCES

New Listings

May 9-12: **7th DOD Conference on Directed Energy Weapon Vulnerability, Survivability and Effects,** U.S. Naval Postgraduate School, Monterey, CA. Contact: Donna Richard, Booz, Allen & Hamilton, Inc., 1300 N. 17th St., Suite 1610, Rosslyn, VA 22209, (703) 527-5429 (see p.12).

May 16-18: **8th Annual Conference on Properties and Applications of Magnetic Materials,** McCormick Centre Hotel, Chicago, IL. Contact: Prof. Messinger, Dept. of Electrical and Computer Engineering, Illinois Institute of Technology, 3301 S. Dearborn St., Chicago, IL 60616.

May 25-27: **Interaction Mechanisms of Low-Level Electromagnetic Fields in Living Systems–Resonant Phenomena,** Stockholm, Sweden. Contact: Dr. Hans Lundberg, Royal Swedish Academy of Sciences, PO Box 50005, S-104 05, Stockholm, Sweden, (46) 8-150430.

June 21: **Annual Meeting of the Society for Light Treatment and Biological Rhythms,** National Institutes of Health, Bethesda, MD. Contact: Dr. Daniel Kripke, Veterans Administration Medical Center V116A, 3350 La Jolla Village Dr., San Diego, CA 92161, (619) 453-7500, ext. 3436.

July 9-13: **8th Conference on Radiation and Health of the American Statistical Association (ASA),** ***Health Effects of Electric and Magnetic Fields: Statistical Support for Research Strategies,*** Copper Mountain Conference Center, Copper Mountain, CO. Contact: Marilyn Humm, ASA, 1429 Duke St., Alexandria, VA 22314, (703) 684-1221 (see p.12).

September 20-22: **Symposium on Antenna Applications,** Allerton Park, Monticello, IL. Contact: Y.T. Lo, Dept. of Electrical and Computer Engineering, University of Illinois, 1406 W. Green St., Urbana, IL 61801, (217) 333-0293.

September 21-22: **39th Annual Fall Broadcast Symposium,** Hotel Washington, Washington, DC. Contact: Dr. Philip Rubin, Rubin, Bednarek Associates, 1667 K St., NW, Washington, DC 20006.

October 9-10: **21st Annual North American Power Symposium,** University of Missouri-Rolla, Rolla, MO. Contact: Dr. Charles Gross, Electrical Engineering Dept., Auburn University, Auburn, AL 36849, (205) 887-1812.

November 9-12: **11th Annual International Conference of the IEEE Engineering in Medicine and Biology Society,** Seattle, WA. Contact: Francis A. Spelman, Regional Primate Research Center SJ-50, University of Washington, Seattle, WA 98195, (206) 543-0440.

December 4-6: **International Conference on Magnetism and Magnetic Materials,** Rimini, Italy. Contact: Magis International S.r.l., Via Boccaccio, 19, 20123 Milan, Italy.

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January 3-5: **3rd International Interdisciplinary Research Conference on Fundamentals of Bone Growth: Methodology and Applications,** Los Angeles, CA. Contact: Dr. Andrew Dixon, Schools of Dentistry and Medicine, 63-090 CHS, University of California at Los Angeles (UCLA), Los Angeles, CA 90024, (213) 825-1761.

May 7-10: **IEEE 1990 International Radar Conference,** Marriott Crystal Gateway Hotel, Arlington, VA. Contact: Robert T. Hill, ITT Defense, 1000 Wilson Blvd., 30th Fl., Arlington, VA 22209.

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MICRO WAVE NEWS

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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 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)

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 afer a two-hour RF/MW exposure. See p.5.

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 Breysse**'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. Breysse 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), Breysse 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 Wolpow**, 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 million 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.

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.

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."

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 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.

Censorship at the BBC

The British Broadcasting Corp. (BBC) was pressured into dropping an interview with the CEGB'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.

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 Communications 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.

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^2. The device is the first of its kind, making it possible to warn of possible overexposure 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^2. 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.

(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 Guimond**, Director, Office of Radiation Programs, Environmental Protection Agency (EPA); **Karen Larsen**, Senior Analyst, Office of Technology Assessment (OTA); **Jack Lee, Jr.**, Environmental Health Specialist, Bonneville 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); **Regina Siberski**, 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

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 Easterly 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-

lano, 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 rezipping....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 "Biomineralization of Ferrimagnetic Greigite (Fe_3S_4) and Iron Pyrite (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 Åarhus 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 Åarhus 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 reasonable 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 coworker 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 Breysse reported that telephone cable splicers had a 70% increased risk for brain tumors (see *MWN*, N/D89).

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EMF Brain† 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).	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.
Samuel Milham, Jr., "Mortality in Workers Exposed to Electromagnetic Fields," *Environmental Health Perspectives, 62*, pp.297-300, 1985 (see *MWN*, M/A86).	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% ($p<0.05$).
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).	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 ($p<0.05$).
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).	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."
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).	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).
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).	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).
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).	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 ($p<0.07$).
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.	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, $p=0.008$).
Genevieve Matanoski, Elizabeth Elliott and Patrick Breysse, "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).	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.

† 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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MICRO WAVE NEWS

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Deciphering Wire Codes: USC Data Analysis Continues

With the release of Dr. John Peters's findings of a significant association between childhood leukemia and wire codes—but only a weak, nonsignificant association with measured electromagnetic fields (EMFs)—researchers are again asking: What do wire codes reveal about EMF exposures that short-term and spot measurements do not?

Among the variables under study are high frequency transients, angles of the magnetic fields, the earth's magnetic field, resonance conditions, on-and-off field exposures, ground currents and harmonics—as well as non-EMF factors, such as traffic density.

Dr. Nancy Wertheimer told *Microwave News* that a number of researchers who attended the Electric Power Research Institute's (EPRI) workshop, held February 5-8 in Carmel, CA, felt that, "There seems to be something with wire codes—let's find out what it is." Wertheimer and Ed Leeper, both based in Boulder, CO, devised wire coding as a method to estimate residential magnetic field exposures for their landmark 1979 study.

Peters, an epidemiologist at the University of Southern California (USC) in Los Angeles, presented preliminary results of his study at the EPRI workshop (see *MWN*, J/F91 and p.13). EPRI sponsored the USC study.

Data analysis on the five-year study continues. Dr. Joseph Bowman, a member of Peters's team, told *Microwave News*, "We have a lot more data than went into the report that EPRI released." Bowman, who recently left

(continued on p.12)

NIOSH Finds No VDT Miscarriage Risk; EMF Conclusion Sparks Debate

Telephone operators who use conventional cathode ray tube (CRT) video display terminals (VDTs) are no more likely to miscarry than are those who use other types of displays, according to a long-awaited epidemiological study by the National Institute for Occupational Safety and Health (NIOSH) in Cincinnati, OH. The NIOSH team did not find a dose–response relationship between the number of hours spent at a VDT and the risk of miscarriage, and there was no evidence of an excess risk when the data were broken down into early and late miscarriages.

NIOSH will use the same data set for a study on VDTs and birth defects, low birth weight and pre-term births—these results are expected to be released in about a year and a half.

In the March 14 issue of *The New England Journal of Medicine*, Dr. Teresa Schnorr and coworkers concluded that, "The use of VDTs and exposure to the accompanying electromagnetic fields [EMFs] were not associated with

(continued on p.10)

ELF NEWS

« Power Line Talk »

As the invited luncheon speakers at *Transmission & Distribution* magazine's *Conference on Electric and Magnetic Fields* on February 26, U.S. Rep. **Frank Pallone** (D-NJ) and *The New Yorker*'s **Paul Brodeur** expressed concerns about past utility funding of EMF research and the move toward joint utility–government sponsorship. Asked during Q&A about this funding strategy proposed by the Large Public Power Council and now being pursued by the Health Effects Institute (see *MWN*, M/J90 and p.6), Pallone warned that it is necessary to avoid even the appearance of bias. Brodeur charged that the industry is dealing with EMFs as a public relations problem instead of as a medical issue. He asked the conferees whether they were "beginning to realize that EPRI has been telling you all this time not what you needed to know but what it thought you wanted to hear?" He challenged the positions of EEPA, EEI, EPRI, ERI and IEEE, branding them "wagons of the electric utility industry's E-train." Brodeur issued a warning: "As the lawsuits proliferate, so will damage awards, out-of-court settlements and legal costs....there will be a firestorm of public outrage that will result in major regulatory changes in the way utilities are allowed to conduct their business."

«« »»

Does living near power lines increase the risk of developing cancer? The *Journal of the American Medical Association* posed this question to Dr. **David Savitz** of the University of North Carolina in Chapel Hill. In his response, published in the March 20 issue, Savitz said: "Most reviewers of [the scientific literature] conclude that it falls short of demonstrating a causal relationship.... Nonetheless, from a public health perspective, [there] are clear suggestions of potential adverse effects on health that should be taken seriously." Ongoing research should help resolve the uncertainty, he added, predicting "substantial progress" in the next two to three years. In the meantime, the present level of knowledge is a "sufficient basis for some concern," Savitz advised, "but not necessarily action."

«« »»

The **U.K.'s National Radiological Protection Board** (NRPB) has joined the call for more research into EMF health effects. The lead editorial in the February 1991 issue of the NRPB's *Radiological Protection Bulletin* states that no firm EMF–cancer link has been established but adds that, "It is essential, however, that sufficient research in this area continues to be undertaken, covering epidemiology, experimental and theoretical studies, to enable exposure standards to be confirmed or revised if necessary on the basis of developing scientific knowledge." The NRPB is in the process of reviewing EPA's report on EMFs and cancer (see *MWN*, J/F91).

«« »»

In January, the **Colorado Public Utilities Commission** (PUC) adopted rules requiring utilities to provide new customers with information that compares the cost of extending electric service to the cost of alternative photovoltaic solar power. Although the PUC points to the positive economics of solar energy, the new rules may be the result of a December 1989 PUC statement which cited the need for alternative power supply sources to reduce EMF levels from power lines. That report recommended a policy of prudent avoidance, stating that utility system upgrades are "no longer acceptable" unless efforts are made to "reduce or mitigate the necessity" for such enhancements (see *MWN*, N/D89). In that decision, the PUC granted permission for two new high voltage power lines. However, on February 7, Douglas County Judge Thomas Curry reversed the PUC's approval of the lines—but did prudent avoidance get struck down also? Stay tuned.

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The ***Los Angeles Times*** has set a precedent by becoming the first major American daily to cover the EMF controversy on its editorial page. In the February 11 issue, the *Times* editors made the case for further research into EMF health effects, citing the Peters study (see p.13) as the latest indication that, "Something is going on...." They, like many others, recommended a strategy of "prudent avoidance" until more is known about the EMF–cancer link. The February 24 *Times* featured an op-ed piece by Peter Asmus, author of the book *In Search of Environmental Excellence*, who argued that EMFs are fast emerging as the "utility environmental issue of the 1990s" and concluded that, "In this era of environmentalism, utilities as well as other businesses need to learn how to respond effectively to public concerns and to include the public as stake holders in future decision making. With the stakes so high on both sides, it makes sense to start by talking." The ***Nashville Banner*** took a similar position in a March 26 editorial expressing concern over magnetic fields at a school located next to a 69 kV power line and a 13.8 kV power line. Magnetic fields, measured by an engineer from Nashville Electric Service for the Tennessee paper, ranged from 4 mG in the hallways to 58 mG at the entrance to the band room, directly above the school's main electrical panels. The editors endorsed a policy of prudent avoidance, advising that, "High levels should bring concern not panic."

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The attention generated by "Calamity on Meadow Street," **Paul Brodeur**'s July 9, 1990 *New Yorker* installment, has prompted **EPRI** to publish a booklet to help utilities respond to public inquiries. *Cluster Analyses Do Not Support "Calamity on Meadow Street" Claims*, prepared by Robert Banks Associates of Minneapolis, MN, disputes Brodeur's claim that cancer clusters in Guilford, CT, and Dukeville, NC, were due to EMFs and were not adequately investigated by state health authorities. The report further asserts that Brodeur misrepresented or ignored evi-

dence which contradicted his conclusions. A third cluster reported by Brodeur, in Montecito, CA, is not addressed in the EPRI booklet. The IEEE's Committee on Man and Radiation (COMAR) is circulating another critique of Brodeur's articles, *"Currents of Death" Rectified*. A number of COMAR members contributed to the report, which was edited by Dr. **Eleanor Adair**.

EMF Litigation Heats Up

138 kV Line Challenged in Ohio

A number of Cleveland, OH, business executives have filed suit to block construction of a 138 kV, double circuit transmission line which would run along their street. In a complaint filed on March 12 in Cuyahoga County Court, they charge that electromagnetic fields (EMFs) from the line would endanger approximately 850 people who work along the street and would reduce property values.

The businessmen, who belong to the Lakeside Area Development Corporation (LADCO), at the same time filed a motion for a preliminary injunction to stop construction of the line, which is due to become operational by July 1. A hearing on the motion is set for May 2. The plaintiffs are being represented by attorney Richard Siegel of Cleveland.

The defendants named in the suits are Cleveland Public Power (CPP), the City of Cleveland (which owns CPP), Cleveland Electric Illuminating (CEI) and the Ohio Public Siting Board (OPSB) of the Public Utilities Commission. The board certified the line as safe and necessary on October 29, 1990.

In a third legal action in March, the owners petitioned the OPSB to reopen its docket on the line (No.88-1092-EL-BTX), known as the 138 kV Inland-Lake Shore Transmission Line. They contend that the siting board should have considered possible health risks and that they should have been notified of the board's September 17, 1990 public hearing, since they may be harmed by the line.

The OPSB had previously rejected an informal request by LADCO to review its decision. In a January 31 letter to LADCO President Dennis Frinzl, OPSB Chairwoman Jolynn Barry Butler said that the board would not reconsider its approval for the line. At the same time, she explained that the board's staff was investigating possible EMF health effects in a separate action.

In the petition, the business executives charge that the OPSB's refusal to consider EMF health effects in the Inland-Lake Shore case is "tragically ironic," and that "the medical and scientific communities must be heard from *before* the men and women who work [on their street] are placed at risk."

The business owners contend that operation of the line will be a "medically and scientifically recognized endangerment to the health, safety and well-being" of people working nearby. They also allege that the anticipated presence of the lines and the resulting EMFs "have adversely affected and diminished the value and marketability" of their properties.

The 20-mile line would travel along "uninhabited and seldom populated railroad rights-of-way *except for* a one-half-mile span which... pass[es] directly through and over a densely populated work site...," according to the documents filed by the plaintiffs. All of the companies filing suit are located in that span, according to James Gallo of Gallo Displays, Inc., the lead plaintiff.

"We're trying to buy time," Gallo told *Microwave News*, until the OPSB reconsiders the line on the basis of potential health effects. "We want a power line, but we want a safe power line," he added. Gallo pointed out that the line would be 22 feet from his office and that projected magnetic field levels there would be as high as 350 mG. The estimates were prepared by Bob Huffey, an engineer who is a partner in one of the plaintiff companies.

In addition to forcing a reevaluation of the line, the plaintiffs are seeking lawyers' fees, costs and unspecified compensatory damages. The businesses expect to spend $150,000 on their legal challenges, according to Gallo.

Along with Gallo Displays, the plaintiffs are Beverage Distributors, Inc., Hexagraphics, Inc., Milner Electric Co. and G.R.Z. Properties Co.

Michael Konicek, director of public utilities for the city, told *Microwave News* that he did not want to comment on the case because it is in court. The defendants have not yet filed their responses to the challenges.

Utility Worker's Widow Files Claim

A Seattle, WA, widow claims that her husband's death was caused by his exposure to EMFs while working for Seattle City Light, a public utility. Robert Pilisuk died on April 29, 1989, at age 44, from pneumonia brought on by acute lymphoblastic leukemia.

Pilisuk's widow, Mimi, filed a pension claim on March 20 with the Washington Department of Labor and Industries in Olympia. If successful, she could receive up to $21,000 per year.

Seattle attorney Michael Withey, who is representing Pilisuk, told *Microwave News* that, "This is the first EMF-related pension claim in Washington that I know of." Withey, who is with the Seattle firm of Schroeter, Goldmark & Bender, was also the lead attorney in a major electromagnetic pulse suit (see box on p.4).

Pilisuk's claim is supported by an accompanying letter from Dr. Peter Wright, a medical doctor, stating that Pilisuk's leukemia, first diagnosed in 1987, resulted "on a more probable than not basis, from his employment by Seattle City Light." Pilisuk worked for the utility as an apprentice and journeyman electrician from 1982 until his death, including duty as a cable splicer and as a maintenance electrician.

Preliminary results released in 1989 of an ongoing epidemi-

Attorneys Form Group To Aid EMF Plaintiffs

Lawyers from all across the country have joined forces to evaluate potential electromagnetic field (EMF) cases and litigate on behalf of plaintiffs. The ten-member Electromagnetic Radiation Case Evaluation Team (EMRCET) will seek cases with the potential to set legal precedents.

"We feel that it is important to develop a protocol for the evaluation of electromagnetic radiation cases," the group's founder, Michael Withey of Schroeter, Goldmark & Bender in Seattle, WA, told *Microwave News*. Many previous EMF lawsuits did not establish permanent legal records because they were settled out of court, with the terms kept confidential. (For more on EMF litigation, see *MWN*, Ap81, D82 and S/O89.)

EMRCET members will provide a service to attorneys by investigating and evaluating their EMF cases. They will offer testimony and counsel to citizens' groups and individual plaintiffs. EMRCET was conceived at a November 1990 seminar, *Electromagnetic Fields: Science, Medicine and Public Health*, which was sponsored by the Robert Carl Strom Foundation of Seattle, WA, and Trial Lawyers for Public Justice (TLPJ), a Washington, DC, public interest legal foundation.

"As a consequence of the growing concern about this issue we are going to see more and more EMF litigation," Bruce DeBoskey of Silver & DeBoskey in Denver, CO, one of the organizers of EMRCET, said in a telephone interview. DeBoskey represented Beryl and Maelma Main, who settled a personal injury suit in 1990 alleging that Beryl's non-Hodgkin's lymphoma was caused by RF radiation from an FM transmitter next to their property. The terms of the award were not disclosed (see *MWN*, S/O89 and M/J90).

Withey was the lead attorney representing Robert Strom, a Boeing technician who charged that his leukemia resulted from exposure to electromagnetic pulse (EMP) radiation (see *MWN*, N/D88 and M/J89). In a September 1990 out-of-court settlement, Boeing and codefendants agreed to pay Strom $500,000 and to sponsor a medical program for approximately 700 EMP-exposed workers (see *MWN*, S/O90). Strom used part of his award to set up the Robert Carl Strom Foundation, an EMF information center. Another member of the new EMF law group, William Rossbach of Rossbach & Whiston in Missoula, MT, assisted with the Strom litigation.

The other members of EMRCET are: David Bossart of Conmy, Feste et al. in Fargo, ND; James Browne of James Browne & Associates in Oklahoma City, OK; Macon Cowles of Williams, Trine et al. in Boulder, CO; Anthony Farmer in Knoxville, TN; Kieron Quinn of Quinn, Ward & Kershaw in Baltimore, MD; Anthony Roisman of Cohen, Milstein et al. in Washington, DC; and Aaron Simon of Kazan, McClain et al. in Oakland, CA.

In 1981, Stuart Lemle, a Washington, DC, attorney, and Barton Reppert, a Washington-based journalist, established the Microwave Radiation Information and Action Center to help victims of injuries from exposure to RF/MW radiation (see *MWN*, S81). At the time they were involved in a Freedom of Information Act suit to force the federal government to release materials on Soviet irradiation of the U.S. Embassy in Moscow (see *MWN*, Ja81). Lemle also represented Marie Lafferty, the widow of an FM radio technician who died of leukemia. Lafferty, who claimed that her husband was not adequately warned of the health risks associated with exposures to RF radiation, settled her suit out of court in 1989 (see *MWN*, M/J86 and S/O89).

ological study of telephone linemen showed that cable splicers had significantly elevated rates of a number of different cancers, especially leukemia (see *MWN*, N/D89).

As part of Pilisuk's claim, Withey submitted measurements indicating that, on the average, City Light cable splicers are exposed to 204 mG and constructors, apprentices and helpers are exposed to 13 mG. The data were collected for the Electric Power Research Institute (EPRI) by Dr. Joseph Bowman of the University of Southern California School of Medicine in Los Angeles (see *MWN*, J/F88). Bowman is now at the National Institute for Occupational Safety and Health (NIOSH) in Cincinnati, OH.

In a letter accompanying the claim, Withey and Sidney Stillerman Swan, also of Schroeter, Goldmark & Bender, also suggested that a leukemia cluster may exist at City Light. Citing Dr. Samuel Milham's 1982 epidemiological study of Washington State electrical workers and leukemia (see *MWN*, J/A82), the lawyers wrote that nine or ten of the cancer cases included in those results were electricians who worked for City Light.

Two New Studies Link Worker EMF Exposures to Leukemia

The results of epidemiological studies from the U.S. and France support the hypothesis that workers exposed to electromagnetic fields (EMFs) have an increased risk of leukemia.

A recent survey by the National Institute for Occupational Safety and Health (NIOSH) showed an excess of leukemia deaths among men exposed on the job to EMFs. The NIOSH team, led by Dr. Cynthia Robinson, concluded that the results were "a confirmation that occupational exposure in electrical occupations may be associated with enhanced leukemia risk."

With regard to past occupational studies, the researchers noted a "consistency" of an elevated risk for telephone linemen and installers and for telephone, telegraph and related communications equipment operators. "It's just another indication that we need to look into the excess of leukemia among workers exposed to EMFs," Robinson told *Microwave News*. The team

recommended that further research in this area be "pursued aggressively."

Among the 11 electrical occupations analyzed, the team found a statistically significant 19% increased risk for all leukemia. Communications equipment operators had a statistically significant 399% increase for acute myelogenous leukemia (AML) and a nonsignificant 94% increase for all leukemia. Workers in photographic equipment manufacturing had statistically significant 113% and 57% increases for AML and in all leukemia, respectively. Among telephone linemen and repairmen, there was a 247% increase for AML and a 110% increase for all leukemia, neither of which was statistically significant.

The researchers pointed out that in addition to EMF exposures, these occupations may also involve exposures to suspected leukemogenic chemicals.

They analyzed mortality data on 426,705 white men from 14 states covering one or more years from 1979 through 1985. Robinson noted that the data base used was "large" and "up-to-date."

The French study, conducted by Drs. Sylvie Bastuji-Garin and Sylvia Richardson, of Institut National de la Santé et de la Recherche Médicale (INSERM), and Dr. Robert Zittoun of l'Hôtel-Dieu hospital, both in Paris, identified a statistically significant 304% increased risk of AML among workers exposed to EMFs on the job, such as electrical engineers and electronics technicians. They did not find an increased risk for electric-arc welders.

The results also revealed a statistically significant risk of leukemia for workers exposed to benzene and weed killers. When adjustments were made for these possible confounders as well as for a history of radiotherapy or chemotherapy, there was still a statistically significant 220% increase of AML for EMF-exposed workers.

The French team questioned 185 leukemia patients and 513 controls between 1984 and 1988. Most of the cases and controls were not exposed on the job to EMFs, however, leading the researchers to warn that although the observed risk increase is notable, "this value should be treated prudently" since it is based on a small number of exposed cases.

The NIOSH paper appeared in the *Journal of Occupational Medicine, 33*, pp.160-162, February 1991. The French study was published in the *European Journal of Cancer, 26*, pp.1119-1120, 1990.

JHU Male Breast Cancer Findings Published

Dr. Genevieve Matanoski and colleagues at the Johns Hopkins University (JHU) School of Hygiene and Public Health in Baltimore, MD, have published their finding of an excess of male breast cancer among New York State central office telephone technicians (see *MWN*, N/D89). Their results appear in a letter in *The Lancet* (p.737, March 23, 1991).

In a survey of 50,582 workers, including 9,561 central office technicians, employed from 1976 to 1980, Matanoski and Drs. Patrick Breysse and Elizabeth Elliott identified two cases of male breast cancer—more than six times the expected rate.

They also confirmed previous reports of four other cases of male breast cancer among telephone workers—two central office technicians, one cable splicer and one non-lineman—who were excluded from the study population because they were either too old (over 65) or were diagnosed with the disease before 1976.

The central office technicians worked near on–off switching equipment which generated EMF spikes. Some researchers have suggested that these complex fields may be more biologically effective than conventional 60 Hz exposures.

Matanoski reported that the central office technicians had mean daily exposures of 2.5 mG, while cable splicers had mean exposures of 4.3 mG. Others in the study were exposed to 1.5-1.7 mG.

The researchers pointed to possible EMF-induced changes in pineal gland activity to explain the excess of male breast cancer. The pineal gland produces melatonin, which can suppress cancer growth (see *MWN*, M/J88, J/A90 and S/O90).

After Matanoski reported the male breast cancer finding in 1989, other researchers soon began to pursue the link. Last summer, Paul Demers of the Fred Hutchinson Cancer Research Center in Seattle, WA, found a statistically significant six-fold increase among telephone linemen, electricians and electric power workers. Overall, there was a near-doubling of the male breast cancer risk among all EMF-exposed workers (see *MWN*, J/A90). In a third report, Drs. Tore Tynes and Aage Andersen of the Cancer Registry of Norway in Oslo identified a significant doubling of breast cancer in EMF-exposed workers (see *MWN*, J/F91).

IEEE: ELF Magnetic Field Meters Are "Satisfactory"

The overall performances of 14 extremely low frequency (ELF) magnetic field monitors were "satisfactory," according to a survey by the Magnetic Fields Task Force of the Institute of Electrical and Electronics Engineers' (IEEE) Power Engineering Society.

The task force also concluded that it was more difficult to achieve consistent measurements of the magnetic fields from electrical appliances than from power lines because of "nonuniformity and harmonic content...." There were considerable variations in frequency response among the meters, which can influence performance in environments where harmonics are present, the group noted.

The task force's assessment grew out of a workshop in which power frequency magnetic field meters on the market in 1989 were tested for calibration and harmonic response, sus-

ceptibility to high 60 Hz electric fields and electromagnetic interference. The meters were also used to measure ELF fields from typical transmission lines, appliances, substations and office machines in a typical work environment. The task force's paper appears in the January 1991 issue of *IEEE Transactions on Power Delivery* (*6*, pp.373-383).

The field survey instruments, data recorders and personal exposure meters evaluated were: Electric Field Measurements' 116 Plus, 120 and EMDEX-C; Electric Power Research Institute's STAR/VANA, EMDEX and AMEX; Holaday Industries' HI-3600-02; Integrity Electronics & Research's IER-109; IREQ's Electric and Magnetic Field Recording Instrument and Dosimeter; Monitor Industries' 42B-1; Positron Industries' Electromagnetic Dosimeter; and Sydkraft's 88-05 and 3-dimensional magnetic flux density meter. (For a list of ELF gaussmeters and dosimeters, see *MWN*, J/F90 and M/J90.)

Among the other findings were significant differences among the exposure measurements made by the data recorders in a low field (<10 mG) environment, but not in a high field (≈40-50 mG) environment.

The workshop was held at the Bonneville Power Administration Laboratory in Vancouver, WA, in May 1989 and was organized by the IEEE AC Fields Working Group of the Corona and Field Effects Subcommittee of the Transmission and Distribution Committee.

The Environmental Protection Agency (EPA) is also evaluating non-recording ELF gaussmeters (see *MWN*, J/A90).

Pallone Again Seeks EMF Research Funding

Rep. Frank Pallone (D-NJ) is again sponsoring federal legislation to allocate $34 million to the Department of Energy over five years for EMF research. H.R.1483, which is identical to the bill Pallone authored last year, was introduced on March 19 with 23 cosponsors (see *MWN*, M/J90 and J/A90).

The proposal would provide increasing levels of funding each year, reaching $10 million in 1995 to pay for health effects and engineering research, as well as for public information. It was referred to the House Committee on Science, Space and Technology and to the House Committee on Energy and Commerce.

Rep. George Brown (D-CA), chairman of the House Committee on Science, Space and Technology, and Rep. James Scheuer (D-NY), chairman of the Science Committee's new Subcommittee on Environment, are among the sponsors of Pallone's bill.

Last year, Pallone's legislation received bipartisan support at a hearing of the House Committee on Science, Space and Technology's Subcommittee on Natural Resources, Agriculture Research and Environment (see *MWN*, J/A90).

Public–Private EMF Research Program Moves Forward

An industry-led effort to set up an independent research program funded equally by the federal government and by the private sector is gaining momentum. The Health Effects Institute (HEI), a Cambridge, MA, nonprofit research organization, is the leading contender to coordinate the multiyear, multimillion-dollar effort. Indeed, HEI has already begun studying the feasibility of taking on this project.

Electric utilities and computer manufacturers have been seeking to sponsor independent research programs for the past year as reports of EMF-linked health effects have reached a broad public audience and federal funding has not increased significantly.

The HEI feasibility study, which is being funded by the Environmental Protection Agency (EPA) and private companies, will cost "up to a couple of hundred thousand dollars," according to HEI Executive Director Dr. Andrew Sivak. He expects to receive $525,000 from EPA and to raise an equal amount in private matching funds. At least one labor union has also expressed interest in contributing to the research budget, he said. Sivak envisions a full-scale research program with a budget of $5-6 million per year.

HEI is assembling a scientific board to direct the feasibility study, but its members have not yet been selected, according to Sivak. Nevertheless, the board is tentatively scheduled to make its final recommendations to HEI's board of directors this fall.

The feasibility study is being managed for HEI by Dr. Peter Valberg of the Gradient Corporation, a Cambridge, MA, consulting firm.

EPA's contribution is expected to come out of $750,000 appropriated by Congress late last year at the urging of Rep. George Brown (D-CA). Earlier, Brown's amendment allocating $1 million to EPA for EMF research was deleted from the budget (see *MWN*, J/A90). At press time, Sivak was waiting for EPA's final approval.

In January, Brown was elected chairman of the House of Representatives Science, Space and Technology Committee, increasing his authority to act on EMFs.

Rep. Frank Pallone (D-NJ), who has reintroduced legislation to increase federal EMF research funding (see box at left), prefers that the research be sponsored and supervised by the federal government. Speaking to an audience of electric industry officials on February 26, Pallone said that only government research can have the credibility that is needed to resolve questions about EMFs (see p.2).

The HEI effort grew out of a proposal made last spring by James Cunningham on behalf of the Large Public Power Council (LPPC). Testifying before the House Interior Subcommittee on General Oversight and Investigation, Cunningham called for a $15-20-million industry-funded, government-supervised research program (see *MWN*, M/A90). "We recognize that there is a perceived bias in research funded by the utility

industry," Cunningham explained. "We deny this bias, but we cannot ignore the perception." Cunningham is a senior vice president of the New York Power Authority (NYPA), an LPPC member.

Industry support for EMF research grew at a July congressional hearing. Testifying before the House Science, Space and Technology Subcommittee on Natural Resources, Agriculture Research and Environment, Apple Computer's Dr. David Nagel offered to help fund federal EMF research (see *MWN*, J/A90 and box on p.9). He called for "cost sharing or matching government–industry contributions done at arms length to ensure the highest level of credibility and public acceptance of the results."

According to HEI's Sivak, Cunningham approached him late last year on the advice of EPA and congressional officials. Sivak later met with representatives of the Electric Power Research Institute (EPRI)—which initially resisted the LPPC plan but is now working with HEI. Apple and the Edison Electric Institute, among others, are also backing a coordinated research project.

In a telephone interview, Anne Strauss, a spokeswoman for NYPA, called HEI "the leading candidate" to head the LPPC national study effort. Other organizations considered included the National Academy of Sciences, the National Institute for Environmental Health Sciences and academic institutions.

A joint private–public research effort has also gained the support of the National Association of Regulatory Utility Commissioners (NARUC), which approved a resolution at its winter meeting in February calling for additional federal funds and nonfederal matching funds to support EMF research through an independent organization. NARUC's Tom Choman refused to endorse the HEI project, however.

The HEI feasibility study got under way on March 18 at a briefing to educate the group's research committee on the status of EMF research, according to Valberg. The invited speakers were: Dr. Larry Anderson of Battelle Pacific Northwest Laboratory in Richland, WA, on experimental animal responses; Dr. Granger Morgan of Carnegie Mellon University in Pittsburgh, PA, on general research and policy questions; Dr. Jeffrey Saffer of the Jackson Laboratory in Bar Harbor, ME, on cell and molecular responses; Dr. David Savitz of the University of North Carolina in Chapel Hill on epidemiology; and Dr. Stanley Sussman of EPRI in Palo Alto, CA, on measurement and exposure.

HEI is best known for its work on the health effects of motor vehicle emissions and asbestos. The vehicle emissions research was funded by a 50-50 partnership between the auto industry and EPA.

HIGHLIGHTS

Cancer Cases Spurring Concern over Police Radar

A United States Park Police officer and his wife have filed a $10 million lawsuit against Kustom Signals, Inc., of Overland Park, KS, the manufacturer of the traffic radar unit he used on the job. Hyman Rosen, who developed skin cancer after operating a Kustom MR-9 radar device regularly for almost seven years, is the first police officer to claim in court that exposure to microwaves from a traffic radar caused cancer.

At least two other suits are expected to follow as a growing number of cancer cases have surfaced among police officers who have worked with radar units.

From 1980 to 1987, while working in San Francisco, CA, Rosen used a radar unit that hung on the car window behind his head. In 1986, Rosen was diagnosed with a melanoma on the back of his neck; it was removed, but the cancer recurred.

Rosen's suit seeks compensation for strict product liability, negligence and—on behalf of his wife, Irene—loss of services. It was filed on March 12 in U.S. District Court for the Northern District of California, in San Francisco, by attorney John Sweeney of Sweeney & Pafundi in Agoura Hills, CA.

William Ruppert, a partner in Kustom Signals, told Microwave News that, "We don't think the suit has any merit."

Late last year, Ohio State Highway Patrol (OSHP) Trooper Gary Poynter called public attention to several police officers who had developed cancer after using traffic radar. More officers with cancer have since come forward. Among the cases identified by Poynter are:

- *California officer Eric Bendure and his instructor, Leo Hutchinson*, both developed cancer where they rested their active radar "guns" when not taking traffic speed readings. Bendure's lymphoma originated in his groin, while Hutchinson's cancer originated in his leg. Sweeney told *Microwave News* that he will file two suits in early April: Bendure will sue Kustom Signals and MPD, Inc., a manufacturer based in Owensboro, KY, and Hutchinson will sue Kustom.
- Arnold Sudbrink, a Wisconsin state trooper, developed eye cancer after operating a radar unit mounted less than half a meter directly behind his head. Sudbrink died on September 12, 1990.
- Sergeant Wayne Vessels of Ohio developed skin cancer below his right ear after long-term use of a unit similar to Sudbrink's. The cancer later spread to his face, eye and brain, before it was removed. Vessels has retired and is now working as a janitor.
- Officer Phil Quandt, a St. Petersburg, FL, traffic officer, developed a melanoma on his eyelid after operating a police radar since 1986. The cancer was removed and Quandt is back on duty.

Quandt's cancer, together with Poynter's warnings, led the St. Petersburg Police Department to suspend use of its radars in January. At least 18 other Florida police departments also stopped using their radar equipment after learning of the St.

Petersburg decision. Some of the departments have resumed using the radars with modified operating procedures.

There are at least three types of traffic radars: those mounted on the dashboard, those mounted either on the window or behind the driver and those that are hand-held. The hand-held units are similar to the "guns" used by baseball teams to gauge speeds of pitched balls. Both use continuous wave radiation; the speeds of moving cars are measured by Doppler shifts. Poynter has estimated that a traffic officer using a radar unit is exposed "for hours every day" and that, "The cumulative total is thousands of hours in a very near field...."

Poynter has generated interest in the possible radar–cancer link. Last year, he completed a 95-page report for the Fraternal Order of Police and the Ohio Labor Council and published a two-part series in *Law Enforcement News* (November 15 and 30, 1990). The series was followed by stories in *USA Today* (February 15, front page) and in the *St. Petersburg Times* (February 7 and 21), among other newspapers.

Norbert Hankin of the U.S. Environmental Protection Agency (EPA) in Washington, DC, told *Microwave News* that he has been fielding questions on possible police radar hazards from police departments all across the nation.

Drs. Robert Davis and Samuel Milham of the Washington State Department of Health in Olympia, alerted to the anecdotal reports by Poynter, are reviewing the health records of 1,000-1,100 Washington State police academy graduates from 1950 to 1980. In a telephone interview, Davis explained that almost all academy graduates in the study period operated radar units 4-8 hours daily for 10-15 years. He hopes to complete the study by spring 1992.

The St. Petersburg police department hired a consultant to measure exposures from its 15 radar units, according to Officer Catherine Rubino, but has not yet decided whether to resume using the radar units. The exposure levels were below the 1982 American National Standards Institute (ANSI) limit of 5 mW/cm^2, she said.

A report prepared by Battelle, a testing laboratory in Columbus, OH, for the Ohio Bureau of Workers' Compensation, concluded that none of the OSHP's hand-held units produced exposures in excess of the ANSI limit. Three of the window-mounted units tested exceeded the ANSI limit, however, and Battelle suggested that "some changes in equipment location and/or operation may be warranted." Battelle took peak readings at four locations inside and four outside each patrol car. All of the units tested were operating at about 10.5 GHz.

OSHP's Superintendent, Colonel Thomas Rice, informed troopers in a February 14 memo that "there is very sound probable cause established through empirical research to believe the K-55 [hand-held] radar poses no health risk to our officers."

A third set of measurements by the Institute for Police Technology and Management (IPTM) in Jacksonville, FL, was consistent with Battelle's. IPTM's Bob Bradley told *Microwave News* that he has consistently recorded power densities of 0.1-0.3 mW/cm^2 in the beam at two inches from the source. He has tested more than 150 units recently using a Narda 8616 meter.

Sandy Shields, a researcher with Florida's Hernando County Sheriff's Office (one of the 19 police departments that had stopped using the radar units), told *Microwave News* that her office decided in early March to relocate the radar antennas to patrol car rooftop light bars to reduce exposures. The cost of the change will be about $20 per radar unit, she said.

There are few epidemiological data on radar exposures and cancer, although an association has been alleged in a number of lawsuits. For more on lawsuits alleging a link between RF/MW exposure and cancer, see *MWN*, D82, J/F83, Jn84, My85, S/O85, J/F86, M/A88, M/J89, S/O89 and N/D90.

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IEEE Panel Rejects VDT EMF Emissions Guidelines

An Institute for Electrical and Electronics Engineers' (IEEE) working group has rejected proposed emissions guidelines for electromagnetic fields (EMFs) from video display terminals (VDTs). The P-1140 working group decided at a March 18 meeting that setting specific limits would exceed its authority.

The working group does plan to issue a measurement protocol for VDT extremely low frequency (ELF) and very low frequency (VLF) fields by July 1. The protocol, along with the emissions guidelines, was developed by a P-1140 ad hoc subgroup working under the direction of Stan Roberts of Apple Computer.

P-1140 will include the guideline levels as an appendix to the measurement protocol, under the heading, "Achievable VDT Emission Levels Using Current Technology," Dheena Moongilan of AT&T Bell Labs in Holmdel, NJ, the chairman of P-1140, told *Microwave News*.

In February, the ad hoc subgroup had recommended establishing guidelines using the same magnetic field values as Sweden's National Board for Measurement and Testing (Statens Mät och Provstyrelse, or MPR) but less stringent electric field limits. The proposed guidelines, which would have been the first in the U.S., may now be taken up by another IEEE committee, according to Moongilan.

The ad hoc subgroup's proposal was unexpected. When it began work last fall, the panel publicly stated that no limits would be developed. But there was "a little pressure" within the group to include them after the measurement protocol was developed, Roberts told *Microwave News*. "Without numbers,

what's it going to mean?" he explained.

Moongilan confirmed that there is a perceived need for guidelines. Some computer manufacturers want specified levels "so that they can put a label on their products stating that they 'meet IEEE guidelines,'" he said.

Dr. Charles Abernethy of Digital Equipment Corp. in Maynard, MA, a member of P-1140, said that no formal action has been taken to refer the guidelines to another working group. He agreed that the computer industry wants to develop emissions guidelines. "We're trying to define what 'low-emission' is," he said in a telephone interview, adding, "Our goal is to get something simple and straightforward that we can agree on."

A major concern of the industry, according to Abernethy, is that Sweden's limits might be adopted by the European Economic Community (EEC). The EEC has a directive calling for the lowest possible emissions levels (see *MWN*, J/A90). "We need to develop a U.S. position to counter Sweden in the EEC," he said, maintaining that the suggested Swedish levels are not distinguishable from ambient fields.

The final ad hoc subgroup draft states that the limits were based on levels "which are technically and reasonably achievable" rather than on health risks. John Chubb of IBM in Research Triangle Park, NC, a member of the P-1140 ad hoc subgroup and a contributor to the development of the Swedish guidelines, told *Microwave News* that the same distinction was made by the MPR.

The IEEE subgroup's magnetic field proposal was the same as Sweden's: 2.5 mG for ELF and 0.25 mG for VLF. For electric fields, the proposed VLF guideline was 10 V/m at 50 cm, compared with the 2.5 V/m level adopted by the MPR. The panel proposed two ELF limits—50 V/m for Class I computers, which use three-prong, grounded power cords, and 250 V/m for Class II units, with two-prong cords. The MPR ELF electric field limit is 25 V/m for all computers.

Roberts explained that trial electric field measurements showed significant differences between the two types of cords, with some Class II units producing fields well above 100 V/m. In a telephone interview from his office in Cupertino, CA, Roberts said that the two-tier limits are meant for use in Europe—where the standard electrical power supply operates at 220 V—as well as in the U.S. He questioned whether the Swedish ELF guideline of 25 V/m is achievable, given the levels produced by the Class II cords.

The ad hoc subgroup's protocol prescribes 24 measurement points for both ELF and VLF magnetic fields, eight each on three horizontal planes: at the center of the terminal, 30 cm above the center and 30 cm below—all at 50 cm from the VDT. For electric fields, the draft requires four VLF readings and only one ELF reading, all at 50 cm from the terminal.

The IEEE methodology measures time-rate-of-change of magnetic fields (dB/dt), while the Swedish guidelines are based on simple magnetic field readings (see *MWN*, S/O88, M/J89 and S/O90).

Unlike the Swedish guidelines, the P-1140 draft does not address electrostatic fields. There was little discussion about them, according to Roberts.

The P-1140 group was originally set up in 1987 to develop VLF measurement procedures for VDTs. In 1989, its mission was expanded to include all electrical and electronic devices. Last August the committee decided to create the ad hoc subgroup to consider VDT emissions before it looked at other devices, and to include ELF EMFs (see *MWN*, J/A87, M/A88, M/J89 and S/O90).

NAS Planning To Evaluate VDT EMFs

The National Research Council (NRC) of the National Academy of Sciences (NAS) is seeking federal funds for an evaluation of research on VDT electromagnetic fields (EMFs). The project was prompted by growing computer industry concern about EMF health effects, according to Dennis Mahlum, the NRC project officer (see *MWN*, J/A90).

Apple Computer in Cupertino, CA, had asked the NAS to undertake the project. In a December 10 letter to NAS President Frank Press, Apple Vice President David Nagel suggested that the NAS recommend a "nationally coordinated program of study to produce the kinds of information which can inform development of design and usage standards for a wide range of exposure conditions."

Apple offered to provide "monetary and other support" in conjunction with other computer companies. Mahlum said that IBM, Digital Equipment Corp. and the Computer Business Equipment Manufacturers Association also "expressed a great deal of interest."

In a December 21 letter, Press agreed that the NAS "should address this important issue." The NAS will not accept industry funding, however, despite the fact that its rules permit it to do so for up to 49% of a project's cost. According to Mahlum, the NAS governing board decided that "this topic is a little bit hot" and wants to avoid the appearance of bias.

The NAS proposal is currently under review by several government agencies, including the Food and Drug Administration (FDA), the National Institute for Environmental Health Studies (NIEHS) and the National Institute for Occupational Safety and Health (NIOSH), Mahlum said, adding that the response so far has been positive. The proposed budget is said to be about $350,000. If funding is secured, Mahlum hopes to select committee members during the spring and to begin work by the summer.

This would be the second NRC panel examining EMFs. A committee set up last year is studying the potential health effects of very low frequency (VLF) radiation from the U.S. Air Force's Ground Wave Emergency Network (GWEN), with a final report due in September (see *MWN*, M/J90 and N/D90).

an increased risk of spontaneous abortion...."

The reference to EMFs surprised many observers, since the study was not designed to assess EMF reproductive risks and EMF measurements were not taken until more than one-and-a-half years after the last subject was interviewed. Moreover, according to the study's published abstract, these measurements revealed that, "Abdominal exposure to extremely low frequency [ELF] fields (45 to 60 Hz) was similar for both operators who used VDTs and those who did not."

"It was a well-designed study and makes an important contribution to the debate, but I am concerned about its limitations—particularly that it could not address ELF EMFs since the control group was exposed," said Dr. Michele Marcus of the Mount Sinai School of Medicine in New York City.

In a telephone interview with *Microwave News*, Schnorr explained that, "Since we could not conclude anything on stress and ergonomics, that left one distinct characteristic associated with VDTs—the presence of EMFs." NIOSH had planned to include questions on fertility and stress in the study, but was forced to delete them by the federal Office of Management and Budget (see *MWN*, S/O86).

The case group in the study comprised directory assistance telephone operators who worked with CRT VDTs at BellSouth offices. General—dial "0"—telephone operators who worked with light-emitting diode (LED) or neon glow tube (NGT) displays at AT&T offices served as the control group. Schnorr said that AT&T would not say how many in the control group used LEDs and how many used NGTs.

Operators using NGTs had half the abdominal ELF exposures of operators using LEDs. Schnorr said that the controls' ELF exposures were due to background EMFs and were not due to the equipment they were using (see box on p.11).

The NIOSH measurements also showed as much as a 15-fold difference in the very low frequency (VLF) magnetic field emissions of the same model IBM VDTs. In some cases, there was more than a three-fold difference in ELF magnetic field emissions from the IBM VDTs.

"We found a lot of variability between different VDTs, but given the low levels of EMFs, the exposures are not that variable," Schnorr said, adding that, overall, "The EMF exposures among the VDT operators were quite low."

The study met with mixed reactions from epidemiologists working on other VDT–reproductive risk studies. "Overall, the NIOSH study is a strong piece of work, but there are some questions which it was not designed to answer, like the role of ergonomics and job stress," Dr. Robert Hiatt of Kaiser Permanente in Oakland, CA, told *Microwave News*. In 1988, Hiatt coauthored a study with Marilyn Goldhaber and Michael Polen, also of Kaiser, which found that women who worked at VDTs more than 20 hours a week during the first trimester had approximately twice as many miscarriages as women who did not use VDTs (see *MWN*, M/J88).

Mount Sinai's Dr. Marcus noted that the NIOSH study does not shed any light on subclinical miscarriages—those which occur too early to be recognized by the mothers. Previous animal and epidemiological studies have suggested that any increased risk of miscarriage from VDT work is most likely to be in the earliest stages of pregnancy (see *MWN*, J/F90).

Marcus is currently directing a prospective study of reproductive risks from VDT work, which will include data on subclinical miscarriages, job stress and ergonomics (see *MWN*, Jn85, M/J87 and J/A89). It is now in the early stages of data collection. Hiatt is also working on a prospective study of VDT reproductive risks, which he estimates will be completed in two

(continued on p.12)

More VDT–Pregnancy Studies

In addition to the much-publicized NIOSH paper, two other epidemiological studies on possible reproductive risks from VDT work have recently been released.

Dr. Gayle Windham and coworkers at the California Department of Health Services in Berkeley found a slightly increased—though nonsignificant—risk of miscarriages among VDT workers. Miscarriages in the first trimester were more likely than later miscarriages to have an association with VDT work—agreeing with several animal studies (see *MWN*, J/F90). Windham's team compared a subset of their data taken from members of Kaiser Permanente clinics with an earlier study of Kaiser members which showed a significant association between VDT use and miscarriages (see *MWN*, M/J88). Interestingly, the results again showed that Kaiser VDT users were approximately twice as likely to have miscarriages as nonusers. Windham also detected an elevated risk of low birth weight and intrauterine growth retardation for the offspring of frequent VDT users—though this finding was also not statistically significant.

In a second study, Drs. Lars Brandt and Claus Vinter Nielsen of the University of Åarhus in Denmark found no substantial or statistically significant increase in the risk of miscarriage—regardless of the amount of time spent working at a VDT. The study did show a statistically nonsignificant 80% increase in the incidence of congenital malformations among children of VDT operators who had a high level of job stress. The risk of one type of birth defect, hydrocephalus (water on the brain), was 12 times higher than expected and was statistically significant. Brandt and Nielsen had previously released preliminary results from their study (see *MWN*, M/A90).

See Gayle Windham et al., "Use of [VDTs] During Pregnancy and the Risk of Spontaneous Abortion, Low Birth Weight or Intrauterine Growth Retardation," *American Journal of Industrial Medicine, 18*, pp.675-688, 1990; Claus Nielsen and Lars Brandt, "Spontaneous Abortion Among Women Using [VDTs]," *Scandinavian Journal of Work, Environment & Health, 16*, pp.323-328, October 1990; and "Congenital Malformations Among Children of Women Working with [VDTs]," *ibid.*, pp.329-333.

NIOSH EMF Survey Most Comprehensive to Date

Seemingly identical video display terminals (VDTs) can emit vastly different levels of very low frequency (VLF) magnetic fields. In the most comprehensive set of EMF measurements ever released in the U.S., Richard Tell of Richard Tell Associates, Inc. found that the VLF fields can vary by as much as a factor of 15 according to how the cathode ray tubes (CRTs) were assembled by different manufacturers.

Tell concluded that the data from the IBM Model 4978 terminals "suggest that there are two substantially different populations of VDTs—some producing significantly greater values of magnetic fields than others, all of the same model number."

The higher-VLF IBM units were assembled by Motorola and the lower-VLF ones by Zenith, according to Tell, even though the units appeared identical on the outside. In the example cited by Tell, at 30 cm from the front of the VDTs, a Motorola–IBM unit produced a VLF magnetic field of 1.02 mG while a Zenith–IBM terminal produced a field of just 0.07 mG. The Motorola–IBM VDT's ELF magnetic field also was higher at 30 cm, though the difference was less pronounced—5.28 mG, as compared to 1.59 mG for the Zenith–IBM VDT.

Tell tested 24 IBM VDTs and the same number made by Computer Consoles Inc. (CCI) for the National Institute for Occupational Safety and Health (NIOSH) as part of its epidemiological study of VDT work and pregnancy risks (see p.1). He also measured emissions from 24 light-emitting diode (LED) displays and from 24 neon glow tube (NGT) displays. He took readings at 30 cm from all six surfaces of the terminals and at the face, chest and abdomen at the operator's position. The measurements were taken at ten BellSouth and AT&T worksites in nine cities. All the LED displays were measured at one office, however; the NGTs were also measured at one, different, site.

He found that the operators of LED displays were exposed to approximately the same extremely low frequency (ELF) magnetic fields at the abdomen as were VDT users—twice the level for the NGT operators. The VLF magnetic field exposures were "substantially less" at the operator's position for both the LED and NGT displays.

The LED and NGT ELF fields did not decay with distance from the units. In a telephone interview with *Microwave News* from his office in Las Vegas, NV, Tell said that these measurements led him to conclude that "the fields are predominantly a function of the ambient fields." The differences between the exposures of the LED and NGT operators were attributed to variations in the office environments.

Tell said that the measurements confirm that differences in emissions among all VDTs "fall within a given distribution—there are differences, but not dramatic differences." He added that, "We are really not going to learn anything miraculous by measuring more VDTs but we may find more quirks like the one I found with the IBM units."

At 30 cm from the front, the CCI units produced ELF fields (at 45 Hz) below 4-5 mG and VLF fields (at 15 kHz) below 2 mG, and the IBM units produced ELF fields (at 60 Hz) below 6-7 mG and VLF fields (at 16 kHz) below 1-1.5 mG. At 30 cm in other directions, however, some ELF field levels were above 30 mG for the CCI units and above 8-9 mG for the IBM units.

Tell found that field levels at the operator's position were higher at the face than at the abdomen or the chest. Mean magnetic field levels at the face were, for ELF, 0.96 mG for the IBM units and 1.03 mG for the CCI units, and for VLF, 0.08 mG and 0.52 mG, respectively.

"[T]he apparent closer distance accounts for the greater value of magnetic field at the face," Tell said. As for electric fields, "It would appear that the head of the operator tends to be somewhat closer to the VDT and tends to attract electric field lines toward the face, thus decreasing the intensity of the electric field lines terminating on the rest of the body."

In his report for NIOSH, Tell included descriptions of the magnetic field waveforms and the calculated body currents induced by the VDT EMFs.

Among other key findings were:

- VDTs do not add significantly to ambient office ELF electric field levels. According to Tell, "ELF electric fields appear to be principally a function of the room electrical environment, probably being more representative of electrical wiring systems used in the building than of any peculiar characteristic of the display."
- VDT EMFs decay rapidly with distance. For example, as the distance between the operator and the VDT doubled, ELF magnetic fields decreased by factors of 1.9-5.4, ELF electric fields by factors of 2.0-6.7, VLF magnetic fields by factors of 1.9-7.2 and VLF electric fields by factors of 3.0-7.1.
- The ELF and VLF fields remained essentially constant whether the display screen was blank or filled with characters.
- Tell compared induced body currents due to VDT EMF exposures to those from radio broadcasts. "Normal exposure to VDTs in the workplace is not significantly different from that induced virtually all of the time by ambient radio station signals to which everyone is exposed," he concluded.
- None of the displays produced detectable X-radiation.

A copy of *An Investigation of Electric and Magnetic Fields and Operator Exposure Produced by VDTs: NIOSH VDT Epidemiology Study* (Report No.PB 91-130-500) is available for $31.00 ($11.00 in microfiche) from: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4650. For more on VDT EMF measurements, see *MWN*, Ap83, S84, O84, D84, J/F85, Ap85, S/O85 and S/O87.

NIOSH VDT–Pregnancy Study (continued from p.10)

years. Both the NIOSH and the earlier Kaiser studies were retrospective.

"The fact that they didn't find an increased risk agrees with the bulk of prior research," Dr. Gayle Windham of the California Department of Health Services (CDHS) in Berkeley told *Microwave News*. She added that, "If studies now under way agree with the NIOSH findings, we won't need much more research in this area." Recently, Windham and coworkers at the CDHS found a small, statistically nonsignificant increase in miscarriages among VDT workers which, they said, followed a "consistent pattern of a possibly slightly increased risk" established by earlier research (see box on p.10).

Schnorr said that she sees the need for studies of ELF EMFs and reproductive risks, though these should be done with a more heavily exposed group than VDT operators. "Our study was intended to determine whether the VDT in itself could cause miscarriages. ELF is a more general question....and one we don't have a handle on yet," she said.

NIOSH first planned a VDT–reproductive risk study in late 1982 (see *MWN*, N82). The final study design was limited to telephone operators who were 18 to 33 years old and worked between January 1, 1983 and August 1, 1986. Pregnancies included in the study were limited to those which ended between January 1, 1983 and December 31, 1986 for miscarriages, and between May 1, 1983 and December 31, 1986 for live births. In all, 2,430 women were interviewed between July 1987 and August 1988; 882 pregnancies were included in the study. See Teresa Schnorr et al., "Video Display Terminals and the Risk of Spontaneous Abortion," *The New England Journal of Medicine, 324*, pp.727-733, 1991.

Deciphering Wire Codes (continued from p.1)

USC to join the National Institute for Occupational Safety and Health (NIOSH), said that the team will have more to say once the study is published—most likely in early summer.

There are indications that the USC data may still yield new and unexpected results. Indeed, EPRI held a small informal workshop on March 19, also in Carmel, to take another look at the data.

Last year, Wertheimer and Leeper proposed that wire codes may predict a combination of field intensity plus angle—the direction of the magnetic field. Using information on field angle, they reanalyzed the data from Dr. David Savitz's childhood cancer study and Dr. Richard Stevens's adult cancer study and found higher cancer risk ratios than were originally reported (see *MWN*, N/D90).

In a telephone interview, Dr. Leonard Sagan, the program manager of EPRI's EMF studies, said, "The question of wire codes needs increased attention. Clearly there's something there that needs to be understood."

Savitz, of the University of North Carolina in Chapel Hill, has long maintained that wire codes are "superior" as a long-term indicator of exposure. Savitz told *Microwave News* that Peters's findings are leading researchers to sharpen their focus on what wire codes say about residential exposures. The study "narrows the range of alternative explanations for the entire body of literature," he said.

Savitz suggested that spot measurements may be "the precise measure at the wrong time" while wire codes are "a rough measure that covers the correct time period."

"There's a lot less fluctuation in wire codes than in measurements. Perhaps the critical variable is better measured by wire codes," Dr. Samuel Milham of the Washington State Department of Health in Olympia said in an interview.

Wertheimer commented, "Measurements may not be the gold standard because we don't know what to measure." And Sagan added that, "Time-weighted averages of magnetic fields now seem to be of decreasing importance, but that doesn't mean that magnetic fields are off the hook."

Wire codes may point to other conditions not directly related to magnetic field exposures. Dr. Patricia Buffler of the University of Texas School of Public Health in Houston, who chaired the February Carmel workshop, said that the observed association may be related to traffic density and/or lower socioeconomic status: "Before you conclude that wire codes are an EMF surrogate, you have to address these other questions." Sagan concurred, pointing out the need to look at what wire codes mean in terms of demographics—the specific populations living in high-current configuration and low-current configuration homes.

Savitz also noted that contaminated drinking water from pipes corroded by ground currents may be responsible. But, he said, "If you accept that wire codes are related to cancer risk, then I think the leading candidate is magnetic field exposure."

Sagan cited a need for non-epidemiological research. "Laboratory studies have become increasingly important. We need to do both whole animal and cellular studies," he said.

Swedish EMF–Cancer Study Expected Soon

The results of an epidemiological study of leukemia and brain tumors among EMF-exposed workers by Drs. Siv Tornqvist, Bengt Knave and colleagues (see *MWN*, N/D89) were also presented at the EPRI epidemiological workshop in Carmel, CA.

Tornqvist and Knave, of the National Institute of Occupational Health (NIOH) in Solna, Sweden, both declined to release details of the study prior to publication. EPRI's Dr. Robert Black, who presented the paper, also refused to comment on the study. The paper is expected to appear shortly in the *British Journal of Industrial Medicine*.

The NIOH team was unable to present the results in person because of travel restrictions related to the war in the Persian Gulf.

USC EMF–Leukemia Study Corroborates Denver Results

On February 7, Dr. John Peters of the University of Southern California (USC) in Los Angeles presented preliminary data showing that children living in homes near high current power lines had a two-and-half-fold increased risk of leukemia (see *MWN*, J/F91 and p.1). The study confirms findings by Dr. Nancy Wertheimer and Ed Leeper and by Dr. David Savitz of a statistically significant association between wire codes and increased childhood cancer risks in Denver, CO.

The greatest leukemia risk for measured magnetic fields was consistently observed in the highest exposure category—a 50% increase—but the association was not statistically significant, according to the Electric Power Research Institute (EPRI), the sponsor of the study. There was no link to electric field measurements.

In a telephone interview, Peters declined to comment directly on his study, saying only that, "I don't think we're ready to put our final interpretation on the results." He noted that the USC team is in the process of verifying the numbers and that he hopes to publish the results by early summer.

In his presentation at an EPRI workshop in Carmel, CA, Peters asked participants not to reveal details of the study. Peters's results were released by EPRI.

Nevertheless, some attendees told *Microwave News* that Peters's study indicated a threshold of about 2 mG for an increased childhood leukemia risk—similar to that reported by Savitz.

"The meeting was a turning point," Dr. Richard Stevens of Battelle Pacific Northwest Lab in Richland, WA, said. "It's now a legitimate field of research taken seriously by mainstream scientists."

In a telephone interview, Dr. David Savitz of the University of North Carolina in Chapel Hill called the Peters study "well-designed and well-executed" and said that, "The results seem very much compatible with our study and with Wertheimer and Leeper's study....In a sense, it corroborates them." In his 1988 study, Savitz also found a more consistent association with wire codes than with measured fields.

The most unexpected finding of the Peters study was a statistically significant link between childhood leukemia and exposures to black-and-white televisions and hair driers. "It is also not clear whether short-term, very high exposure[s] of children to magnetic (or electric) fields from electric appliances are responsible for the observed risk or whether associated exposures are responsible," according to a USC statement released by EPRI. The finding "suggests the need for more emphasis to be placed on examining transient, high-level exposure to fields or threshold effects," EPRI noted in its own public statement.

Some experts who attended the workshop cautioned that too much emphasis has been placed on the issue of appliance use. "I think the critical variables are related to where the house is in the electric distribution system rather than to what is going on inside," Dr. Samuel Milham of the Washington State Department of Health in Olympia said. Indeed, EPRI's Dr. Leonard Sagan told *Microwave News* that the data are "suggestive," but, "I don't think we should make too much of it."

The team looked at 232 cases of childhood leukemia in children no more than ten years old between 1980 and 1987 in Los Angeles County. The cases were matched with the same number of controls. The team took spot measurements and 24-hour to 72-hour continuous measurements in the rooms where the children slept. Exposures were also assessed by wire codes. Parents were interviewed by telephone on appliance use, occupational histories of both parents, environmental exposures and other potential confounders.

UPDATES

COMMUNICATIONS

Antenna Farm Concern... Comsite Pacific Inc., a communications company, moved a pregnant woman and her husband from a house it owns in the middle of an antenna farm in Santa Barbara, CA, to a new residence after measurements revealed radiofrequency (RF) levels as high as 501 $\mu W/cm^2$ in and around the house. Rita and Robert Obenreder were advised by a County of Santa Barbara official that "a potentially significant hazardous health condition exists..." in a January 14 letter. County officials learned of the situation from Bruce Lusignan, a consultant with the Communications Satellite Planning Center in Palo Alto, CA, who notified them in a December 31 letter that "the residence has levels greatly exceeding the ANSI levels... I urge you to take steps to get the residents off the property." Copies of both letters were obtained by *Microwave News*. Lusignan had taken measurements as part of an environmental impact assessment on behalf of Comsite, of Santa Maria, CA, which intends to add 50 antennas to the property, according to the *Santa Barbara News-Press* (January 27). Currently some 600 companies—FM radio stations, paging services, security alarm companies and others—transmit from the 40-acre farm, the paper reported.

INTERNATIONAL

Romanian Bioelectric Society... The recently formed *Romanian Society for Bioelectricity and Bioradiations* will promote education and research into the biological effects of EMFs and NIER. The new group, created in the wake of the downfall of Nikolae Ceausescu, is a "professional, scientific, nongovernmental, nonpolitical society, based upon democratic principles." The president of the society is Dr. Ioan Mamulas and the executive secretary is Dr. Valentin Musat. The society is based at 4-6 Visarion St., District 1, Bucharest, Romania.

LAW

Compensation for Power Line Fears... The courts should recognize EMF fears in determining compensation for property seized under eminent domain proceedings, David Zachary Kaufman argues in a recent law review article. He favors a rule stating that, "Evidence of lost market value due to the fear of adverse health effects may be introduced regardless of the reasonableness of the fear." Citing numerous claims of property value damages due to power line health concerns, Kaufman contends that this rule—as opposed to two others which reject "speculative fears" as a cause of property devaluation—is the most "economically efficient" because it permits landowners to be compensated for decreased market value resulting from both objective and subjective risks. Kaufman refers to a number of well-known power line lawsuits, including *Houston Power and Lighting v. Klein* (see *MWN*, N/D85, N/D87, J/A88 and M/J89) and *San Diego Gas & Electric Co. v. Daley*, although he does not mention the Marcy-South suit (see *MWN*, S/O88 and S/O89). Noting that the courts have been ambivalent about adopting this rule—due to concerns over presenting alarming or inflammatory testimony to the jury about possible health effects—Kaufman suggests that the solution is to omit scientific evidence from the record on the basis that "it is irrelevant and unnecessary and may tend to inflame the jury." Kaufman maintains that trials would then be less confusing to both judge and jury, would be less expensive to all the parties and would proceed at a faster pace. See *George Mason University Law Review, 12*, pp.711-736, 1990.

MEDICAL APPLICATIONS

MRI Safety... In a recent paper, Drs. Frank Shellock and Emanuel Kanal, cochairmen of the Society for Magnetic Resonance Imaging (SMRI) Safety Committee, provide guidelines and suggestions for MRI safety and patient management, including warnings about patients with pacemakers and metal implants. Shellock and Kanal recommend that a "cautious approach" should be taken with pregnant women, particularly during the first trimester, although no "definitive association has been demonstrated" between MRI and effects on the developing fetus. Their paper appeared in the inaugural issue of the *Journal of Magnetic Resonance Imaging*, January/February 1991. Shellock is at the Cedars–Sinai Medical Center in Los Angeles, CA, and Kanal is at the Pittsburgh (PA) NMR Institute.

Magnetic Stimulation... The January 1991 *Journal of Clinical Neurophysiology* is a special issue devoted to "Magnetic Stimulation of the Nervous System." Among the papers are eight review articles, four original contributions and several technology and equipment reviews, covering the history, basic principles and clinical and research applications. Dr. Dudley Dinner of Cleveland, OH, served as the issue's guest editor. It is available for $50.00 from: Raven Press, 1185 Avenue of the Americas, New York, NY 10036, (212) 930-9500. Subscriptions to the quarterly journal, which is the official publication of the American Electroencephalographic Society, are available from the same address: in the U.S., $99.00 for individuals and $165.00 for institutions; elsewhere, $132.00 for individuals and $198.00 for institutions.

TENS for Muscle Spasms... Transcutaneous electrical nerve stimulation (TENS) may be an effective treatment for severe muscle disease, according to a letter in the December 1, 1990 issue of *The Lancet*. Drs. Jennifer Bending and Lynn Cleeves of the U.K.'s National Hospital for Neurology and Neurosurgery in London report that TENS significantly reduced the pain, tremors and involuntary movements of a 34-year-old man with chronic muscle disorders. The patient showed the most improvement when treated with frequencies of 20-25 Hz....See also "TENS for Chronic Low-Back Pain," an editorial in the February 23 issue of *The Lancet;* TENS is ineffective in the treatment of lower back pain, according to a study reported in the June 7, 1990 issue of *The New England Journal of Medicine* (see *MWN*, J/A90).

MEETINGS

NIOSH EMF Meeting Papers... The National Institute for Occupational Safety and Health (NIOSH) will publish a technical report this summer containing the invited papers and summary recommendations from its January 30-31 workshop on occupational EMF exposures (see *MWN*, J/F91), according to NIOSH's Philip Bierbaum. *Proceedings of the NIOSH Workshop on the Health Effects of Electromagnetic Radiation on Workers* will be edited by Bierbaum and Dr. John Peters of the University of Southern California in Los Angeles (see p.1).

1992 IRPA Workshop in Canada... The International Radiation Protection Agency (IRPA) has announced that its *2nd International Workshop on Non-Ionizing Radiation* will be held May 11-14, 1992, at the University of British Columbia (UBC) in Vancouver, Canada. The workshop will precede the *8th IRPA Congress*, to be held May 17-24 in Montreal. A lecture series and panel discussions designed to give participants an overview of the EMF issue will be featured at the workshop. A similar IRPA workshop was held in conjunction with the 1988 congress in Australia (see *MWN*, S/O87). For more information, contact: Dr. Wayne Green, Director of Occupational Health and Safety, 50/2075 Westbrook Mall, UBC, Vancouver, BC V6T 1W5, Canada, (604) 228-4218.

EMF World Congress in 1992... Orlando, FL, will be the site of the *1st World Congress for Electricity and Magnetism in Biology and Medicine*, June 14-19, 1992. The meeting will bring together the interests of those involved with the beneficial aspects of bioelectromagnetics and those concerned with the potential health effects of EMF exposures. For more information, contact: 1st World Congress, c/o W/L Associates, 120 W. Church St., Frederick, MD 21701, (301) 663-1915.

Dr. **Herbert Fröhlich,** a pioneer in the search for theoretical explanations of microwave interactions with biological systems, died on January 23 at the age of 85. A professor emeritus at the U.K.'s University of Liverpool, he was a fellow of the Royal Society....The Canadian Centre for Occupational Health and Safety (CCOHS) in Hamilton, Ontario, has lost its two experts on NIER, Dr. **Karel Marha** and **David Charron.** Marha has opened a consulting firm, Karel Marha & Associates. He had emigrated from Czechoslovakia, where he headed the Department of High Frequency at the Institute of Industrial Hygiene and Occupational Diseases in Prague. Marha, a biophysicist, is the author of *Electromagnetic Fields and the Life Environment.* Charron has joined the Radiation Protection Service of the Ontario Ministry of Labour in Weston. CCOHS spokesman David Cohen told *Microwave News* that the organization will continue its EMF work but has not yet named replacements for Marha and Charron....Dr. **Robert Kulikowski** has been named acting director of New York City's Bureau of Radiation Control, replacing Dr. **Leonard Solon.** Solon, who authored the city's 50 μW/cm² RF/MW standard, will assume other duties....**Warren Sinclair** is retiring from the presidency of the National Council on Radiation Protection and Measurements (NCRP), a position he has held since 1977....**Anthony Valentino** has been appointed vice president of the Applied Sciences Group of the IIT Research Institute (IITRI) in Chicago, IL. He has long been associated with EMF research.

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Radon Rationale... Electrostatic charges on VDT screens can attract airborne radon progeny which might harm computer users, according to Frank Ziemba of the Applied Electron Corp. in Santa Clara, CA. In a recent letter in *Nature* (*349*, pp.659-660, February 21, 1991), he reported finding relatively high levels of radon progeny—radioactive isotopes of polonium, bismuth and lead—on VDTs in his company's office. "My measurements suggest that natural radioactivity and high electrostatic fields are more likely to be the cause of various common complaints," he wrote. In a telephone interview, Ziemba cited reproductive abnormalities and eyestrain as among the possible effects of VDT-related radon exposure. The maximum radon buildup occurs "shortly after" VDTs are turned off, he wrote, when the screen face has a large negative voltage and becomes an "efficient collector" of positive ions. This can continue "for many hours if the air is dry and the main source of air ionization is from the radon background." In his tests, color monitors, which operate at higher voltages than monochrome units, attracted the highest levels of radon particles. Ziemba, who is preparing a more complete report on his findings for publication, told *Microwave News* that the most important safety step is to reduce or eliminate radon levels, and he also recommended preventing VDTs from charging up.

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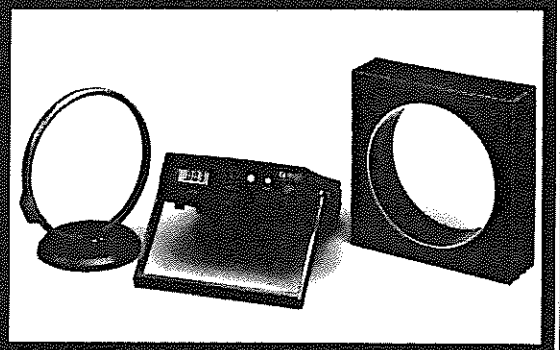
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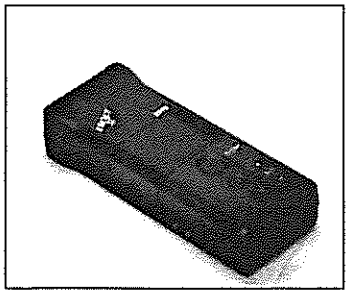
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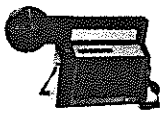
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$65 Million EMF Research Bill Heads to House Floor

The House of Representatives Science, Space and Technology Committee approved a $65 million electromagnetic field (EMF) research and communication measure on March 31 and sent it to the floor of the House as part of the national energy bill. In the process, the committee shortened the research program from ten years to five, effectively doubling the annual research budget. (The bill's ban on outside consulting and expert testimony by researchers was substantially weakened; see box, p.11.)

The House is now likely to act on the EMF research proposal this year since it is attached to legislation that is a high priority for both the President and Congress. However, House leaders have not yet scheduled action on the energy bill. The original EMF bill, H.R.3953, was approved as a backup, with language identical to that in the energy bill.

The EMF legislation has broad support. At a March 10 hearing of the science committee's environment subcommittee, utility, state and labor union officials endorsed H.R.3953 (see *MWN*, N/D91 and J/F92). "We hope this bill becomes law this year," Bob Bergland of the National Rural Electric Cooperative Association (NRECA) told the subcommittee. The Electric Power Research Institute (EPRI) "supports the objectives of the proposed program," said EPRI's Dr. Stanley Sussman.

(continued on p.11)

Strong VDT Magnetic Fields Linked to Higher Rates of Miscarriages

Women who use video display terminals (VDTs) that emit strong magnetic fields may be at a greater risk of having miscarriages than those using low-field VDTs, according to the preliminary results of a new Finnish epidemiological study. This is the first time magnetic field exposures have been an integral part of an epidemiological study of VDT reproductive risks.

Speaking at the *First Congress of the European Bioelectromagnetics Association* (EBEA) in Brussels, Belgium, on January 25, Dr. Maila Hietanen of the Institute of Occupational Health in Helsinki, Finland, reported that VDT operators who were exposed to extremely low frequency (ELF) magnetic fields of greater than 9 mG had a miscarriage risk close to three-and-a-half times greater than those who used VDTs with ELF exposures of less than 4 mG. The increase was statistically significant.

Women exposed to 4-9 mG ELF magnetic fields had nearly twice as many miscarriages as those exposed to less than 4 mG and there appeared to be a dose–response relationship between magnetic fields and miscarriages, but neither finding was significant.

(continued on p.12)

EMF NEWS

« Power Line Talk »

The **DOE** is sticking to its ambitious schedule for developing a unified national EMF research program by this summer (see *MWN*, N/D91), but some federal officials seem wary of the department's way of doing business. Rep. **James Scheuer** (D-NY) objected to DOE's decision to exclude the press, the public and congressional aides from its February 28 meeting of representatives from more than a dozen federal agencies. He delivered a lecture on "open democracy" to DOE's **Michael Davis** at the March 10 congressional hearing on EMF research (see p.1). Davis, assistant secretary for conservation and renewable energy, countered that DOE officials closed the interagency meeting to create "an environment where we could have a no-holds-barred discussion." **Marvin Gunn**, the DOE official directing the planning process, told *Microwave News* that the department convened the meeting to ensure that DOE officials understand what work other agencies are doing on EMFs and to emphasize the need for a unified federal program. He said that he sensed a "clear willingness to cooperate" at the meeting. But one participant who asked for anonymity told *Microwave News* that he could not shake the feeling that the DOE has a "hidden agenda." The DOE will hold additional interagency meetings as needed, Gunn said. The department plans a round of meetings this spring for working groups on science, engineering and communications. Public meetings are also on the agenda; dates and locations will be announced in mid-April, according to Gunn.

«« »»

In February, the **Health Effects Institute**'s (HEI) board of directors concluded that the institute "has an obligation" to pursue EMF research if it can secure adequate funding from the government and the private sector (see *MWN*, N/D91). Based on what has been learned during its planning effort, HEI is preparing a report addressing the question, "Does EMF exposure cause human health effects?" It should be completed by the end of this summer. HEI, based in Cambridge, MA, is ready to implement the five-year research plan that is being developed by the NERP steering committee (see p.5). Alternatively, the HEI board suggests that with $3 million in new funds HEI could collaborate with the National Toxicology Program on its animal studies; or it could develop ways to improve epidemiological studies with an initial grant of $1 million.

«« »»

The **DOE** and **EPRI** have agreed to work together again as joint sponsors of the annual review of EMF research, held every November. At the 1989 meeting, EPRI announced that it would no longer ask its contractors to attend future reviews—instead they would present their findings at the summer meeting of the Bioelectromagnetics Society (see *MWN*, N/D89). A new steering committee has been set up to broaden participation at the meeting and to select the papers to be presented. The members are: Dr. Daniel Driscoll of the New York State Department of Public Service, Paul Gailey of Oak Ridge National Lab, DOE's Dr. Imre Gyuk, EPA's Dr. Doreen Hill and EPRI's Dr. Charles Rafferty. "We are pleased to be working with the other research sponsors to put together a more broadly representative conference on ongoing research," EPRI's Dr. Stan Sussman said in an interview. Driscoll said that he would encourage those who will work on the NERP to attend the reviews. This year's meeting will be held November 8-12 at the Holiday Inn on the Bay in San Diego, CA.

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The **Trial Lawyers for Public Justice (TLPJ) Foundation** will hold its *Second Annual Multidisciplinary Seminar and Citizen Action Conference* on May 15-16 in Ann Arbor, MI. The May 15 seminar is for lawyers, and the May 16 conference is being held to develop "an effective response to the public health hazards of EMFs on the grass-roots and workplace level." The first TLPJ conference, held in November 1990, served to launch the ten-member Electromagnetic Radiation Case Evaluation Team (**EMRCET**), set up to investigate and evaluate EMF cases for attorneys (see *MWN*, M/A91). Speakers at this year's meeting will include EMRCET attorneys, as well as Drs. Abe Liboff, Bruce McLeod and Peter Wright. The registration fee is $150 for May 15 and $25 for May 16. However, lawyers who have represented utilities and manufacturers of EMF-emitting equipment must pay $1,000 to attend the seminar and will be barred from the conference. The Robert Carl Strom Foundation and the Michigan State Trial Lawyers Association are cosponsors of the May meetings. For more information, contact: Michael Withey, Schroeter, Goldmark & Bender, 810 Third Ave., Suite 500, Seattle, WA 98104, (206) 622-8000.

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Answering a spate of recent criticism, Dr. **Granger Morgan** defends the concept of prudent avoidance in the March 15 issue of *Public Utilities Fortnightly*. He responds directly to a vehement attack by the **Electromagnetic Energy Policy Alliance** (EEPA), published last October in the *Health Physics Society Newsletter*. EEPA condemned prudent avoidance as "the abandonment of science" and a "great danger to society, as we know it." Morgan counters that his strategy "is an example of using incomplete science to make a reasoned judgment in the face of uncertainty." He makes it clear that he does not see EMFs as a grave health threat: "On the basis of the epidemiological results, I'd give pretty good odds (better than a 90% chance) that if fields pose a risk, they pose a modest risk (of the order of 1 in 10,000 per year) to all exposed people, rather than posing a very high risk to a few unfortunate people." Yet he argues that these odds still demand prudent avoidance. He adds that, "Whether or not there is a risk, there is a good chance it will be at least a decade before the mainstream scientific community will be able to reach a consensus." While acting on the possibility of a risk "runs contrary to the usual societal habit of declaring everything either safe or hazardous," he suggests, most people in their daily lives know

how to make common sense judgments about uncertain risks. He then asks whether "our legal and regulatory system [is] so set in concrete that we must ignore common sense? I think the answer is no...." Morgan and his colleagues at Carnegie Mellon University in Pittsburgh, PA, Drs. **Indira Nair** and **Keith Florig**, put forward the idea of prudent avoidance in a 1989 OTA report (see *MWN*, J/A89).

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In our last issue, we reported that a committee of top scientists convened by the **JASON** Program Office (JPO) held a meeting to consider EMF health effects. This, however, was just an introductory session: EMFs will now be one of the topics at the JASONs' main summer session, to be held June 15-July 31 in La Jolla, CA, according to DOE officials. The DOE expects a final report by the end of the summer. EMFs were selected from among some 25 issues submitted by various DOE offices, assistant secretary Michael Davis explained at the March 10 congressional hearing (see p.1).

Bowman's Brave New Theory on Geomagnetic Resonances

Dr. Joseph Bowman may have an explanation for the sometimes puzzling results of epidemiological studies of childhood cancer and power frequency magnetic fields. He believes the key to the problem is the earth's static magnetic field.

"When a 60 Hz magnetic field is in resonance with the natural geomagnetic field, there is a trend of increased childhood leukemia risk with *measured* magnetic fields in the University of Southern California [USC] epidemiological study," Bowman told *Microwave News*. His analysis of the USC data resulted in odds ratios (ORs) as high as 6.0 and 9.0 for those exposed to field levels greater than 3.0 mG, although he emphasized that these findings are not statistically significant.

The USC study showed a leukemia risk with wire codes, but not with 24-hour or spot magnetic field measurements (see *MWN*, M/A91 and S/O91). Bowman, a member of the USC team, is now at the National Institute for Occupational Safety and Health in Cincinnati, OH.

Dr. John Peters, the lead investigator of the USC study, thinks that Bowman may be on to something important. "This may be where the answer lies," he said at a March 16 seminar at the Harvard School of Public Health in Boston, MA.

Dr. Abe Liboff of Oakland University in Rochester, MI agrees. "Bowman has struck boldly, like a swashbuckling scientist. He deserves a lot of credit for looking at the earth's magnetic field in the context of epidemiology," he said in a telephone interview.

Bowman said he was inspired by Dr. Carl Blackman's studies on calcium efflux, Liboff's experiments on cyclotron resonance and Russia's Dr. V.V. Lednev's theoretical models. Resonances occur for 60 Hz fields at static fields of 380 mG and 506 mG, according to Bowman's calculations; he assumes that there is a 91 mG bandwidth around each of the two resonances.

Working primarily with Peters and Dr. Duncan Thomas, also of USC, Bowman found that when the cases that fit in these two resonance bands were combined, there was a trend of increasing risk that began climbing at the second lowest power frequency exposure group of 0.7-1.4 mG (OR=2.40) and peaked for those exposed to more than 3.0 mG (OR=6.00). The trend of this dose–response curve approached statistical significance (P=0.056). For the cases in resonance at 380 mG, the risk of developing leukemia was nine times the expected rate. The original USC study found no trend with measured magnetic fields.

Bowman's analysis has been hampered by the small size of the data set and by the intensity of the geomagnetic field in Los Angeles, the site of the USC study. Static field measurements were only available for 128 of the 232 leukemia cases included in the USC study. Of these 128 cases, only 32 were in the 380 mG resonance and only 14 were in the 506 mG resonance—the remaining 82 cases fell between the two.

While applauding Bowman's work, Liboff has doubts about some aspects of the model, including the use of Liboff's own lymphocyte data for determining the width of the resonance bands. Liboff suspects the bandwidths are too large but acknowledges that Bowman's assumptions were driven in part by the need to include a sufficient number of cases to test his hypothesis. "As far as possible, Bowman used the tools available to him, but, at this point, there aren't enough experiments to answer some of the questions that have to go into the analysis," Liboff said.

"There are plenty of questions to be answered and the hypothesis has not yet been thoroughly tested," Bowman said. Nevertheless, he believes that his findings are strong enough to motivate the next generation of childhood cancer studies. He has talked to researchers at the National Cancer Institute who are working on a large-scale EMF–childhood leukemia study, which will include measurements of static magnetic fields (see p.6 and *MWN*, N/D89). Peters and Bowman think that Denver is a good test site for future studies because resonance conditions would be met more often than in Los Angeles. Liboff, however, prefers New Orleans, LA or Phoenix, AZ because their geomagnetic fields are closer to the predicted resonance conditions.

Bowman's model will no doubt encourage researchers to move away from the idea that average magnetic field measurements can predict cancer risks. One of the USC team likened their use of an EMDEX meter to measure fields to evaluating a symphony orchestra with a noise meter, Bowman pointed out.

Bowman said that he has received "fairly heated, but justified, criticism" from a number of scientists since he began discussing his theory. He first presented his findings at the November 1991 Department of Energy Contractors Review in Denver, CO. He maintains that his model has motivated people to think more in terms of mechanisms and to apply theoretical and experimental results to epidemiological studies. "This is the way to go in the future," he said.

Legal and Administrative Notebook

Neurological Claim Against Wisconsin Utility

The parents of a child with a neurological disorder have sued Wisconsin Electric Co., seeking unspecified punitive damages. Leo and Cathy LaBonte of New Berlin, WI, a suburb of Milwaukee, state in their February 26 claim, filed in Waukesha County Circuit Court, that the utility failed to warn them about potential health risks associated with electromagnetic fields (EMFs), particularly for people with neurological disorders. They allege that EMFs from Wisconsin Electric power lines induced seizures in their seven-year-old daughter, who suffers from lissencephaly, a congenital neurological brain disorder. The plaintiffs' attorney, Timothy Aiken, is with the firm of Aiken & Scoptur in Milwaukee.

EMFs inside the family's home ranged from 16 to 27 mG, according to Leo LaBonte's measurements. The utility found EMFs of 10-20 mG indoors and 50 mG outdoors, at the edge of the right-of-way (ROW), under summer peak load conditions. The house is about 70 feet from 230 kV and 138 kV transmission lines, as well as from 26 kV and 8 kV distribution lines, all belonging to Wisconsin Electric.

"There is nothing unusual about the LaBontes' home," Wisconsin Electric's EMF issues coordinator, Jackie Olson, told *Microwave News*. "We feel our facility neither caused nor aggravated their daughter's condition." The Milwaukee-based utility noted in a letter to the LaBontes that EMFs at the edge of the ROW fall below the standards set by Florida and New York—the only two states that have established magnetic field standards for transmission lines.

EMF Trespass Suit Dismissed in Virginia

On February 10, a Hanover County, VA circuit court judge dismissed a lawsuit claiming EMFs as a trespass violation. The plaintiffs will not appeal the decision.

Nineteen local families had filed suit against Virginia Power, alleging that EMFs from the utility's proposed power lines would invade their properties. Judge Richard Taylor agreed with the utility that the State Corporation Commission (SCC), not his court, has authority over power lines. The SCC approved Virginia Power's proposal for the disputed 31.5-mile, 230 kV transmission line in 1990.

The plaintiffs' attorney, Todd Benson, of the Richmond firm of Press, Jones, Waechter & Stoneburner, told *Microwave News* that EMFs constitute a trespass and that the claim is allowed under Virginia anticipatory trespass law. Virginia Power attorney John Holleran, of the Richmond firm of Hunton & Williams, disagreed. "You've got to have a physical invasion to show trespass and since EMFs don't constitute a physical invasion...there's nothing the court can do," he said in a telephone interview.

In his written complaint, Benson called Virginia Power's plan to take a 60-foot easement on either side of the transmission line "grossly inadequate." Dayna Page, principal plaintiff in the suit and leader of Virginia RAGE, Residents Against Giant Electric, told *Microwave News* that the group wanted to be compensated for at least 300 feet of land on each side of the proposed line. She said their goal was to raise costs for the power company and force it to bury the lines. Although the plaintiffs will not appeal—mostly because of high legal costs, according to Page—they are collecting signatures to send to the Army Corps of Engineers, requesting that it prepare another environmental impact report. Page said that a correct assessment would show that construction along the proposed ROW would damage wetlands.

Missouri PSC Approves Power Line Siting

The Missouri Public Service Commission (PSC) decided on December 13 that the Union Electric Co. of St. Louis does not need to mitigate EMFs from a proposed transmission line. In a written report (case no. EA-91-56), the commission said that it cannot order the utility to reduce EMFs when there is no scientific evidence that EMFs from power lines damage health. The commission added, however, that it cannot conclude that EMFs are harmless.

The PSC's findings undermine a local municipality's opposition to the siting of the power line. The city of Linn Creek, in Camden County, sought to block or alter the proposed route for the 161 kV line, 700 feet of which will fall within its bounds. The city intervened before the PSC, claiming that the line would threaten public health and lower property values.

But the PSC, in Jefferson City, approved the line, stating that it will provide reliable service in the face of a growing demand for electricity in the area. Linn Creek had requested that the utility adopt a policy of prudent avoidance and reroute the power line, but the commission responded that the proposed route is the most direct and least intrusive.

PG&E Sued Over Property Sale

A Santa Cruz, CA couple is pursuing a lawsuit against Pacific Gas and Electric (PG&E), claiming that the utility sold them property that it knew was unfit for development. The suit, filed in California Superior Court in 1990, had been on hold until the couple could formally establish that they were denied the intended use of their property, according to Dale Dawson, attorney for the plaintiffs, Jacqueline and Michael Keogh. On February 11, 1992, the Santa Cruz County Board of Supervisors denied the Keoghs' application for a residential subdivision.

The board agreed with the county planning department determination that the property is "not suitable" for the proposed development because "residents would be exposed to unsafe levels of EMFs." The 1.95 acre parcel, which the couple purchased in 1983, contains two 115 kV transmission lines and one 21 kV distribution line, all belonging to PG&E. EMF measurements at the site are as high as 18.7 mG in some locations, according to the board's report.

"The suit was filed because PG&E did not disclose that

there was a problem with high EMFs," Dawson, a partner with the Scotts Valley firm of Dawson, Passafuime & Bowden, told *Microwave News*. Dawson alleges that the utility participated in EMF studies before the sale, and should have, under California real estate law, disclosed any material fact that might affect the value of the property.

But Stephen Jones, with the San Francisco law firm of Sedgwick, Detert, Moran & Arnold, who is representing PG&E, said in a telephone interview that, "Back when the Keoghs purchased the property, no one anticipated there would be a problem in obtaining a building permit." Furthermore, the utility believes that there would be no substantial health risk for residents if the property were to be developed, Jones said.

Legal Advice

• When faced with legal defense fees and possible liability costs, utilities must determine whether these claims will be covered under their insurance policies, writes Keith Meyer in the February 15 issue of *Public Utilities Fortnightly*. Meyer, a partner with the Los Angeles firm of Paul, Hastings, Janofsky & Walker, represents policyholders in insurance litigation. His article urges utilities to fight for the coverage they are entitled to under their CGL (comprehensive general liability) policies before a poor precedent is established. "Too frequently carriers look for ways to deny coverage," he writes. "EMF claims may become the next wave of continuous, progressive disease cases where the total amount of liability could exceed the amount paid out in asbestos cases."

• In a February 19 *Toxics Law Reporter* article, corporate defense lawyer Richard Dandrea argues that claims alleging that EMFs cause cancer should be dismissed before trial. He contends that scientific data establishing an EMF–cancer link are inconclusive—and that any testimony is therefore based on inadequate information and should not be permitted in court. Dandrea notes that, for the same reason, hired consultants should not be permitted to testify that EMFs "probably" caused a plaintiff's cancer. Causation cannot be proved, he concludes, adding that the subject requires "further, more formalized analysis." The *Toxics Law Reporter* is published by the Bureau of National Affairs in Washington, DC.

• When considering what can be done now to minimize the risk of liability in future EMF cases, Paul Hanzlik, a litigator representing public utilities at the Chicago law firm of Hopkins & Sutter, recommends that utilities weigh the following measures: encouraging public utility commissions to establish reasonable EMF standards; mitigating EMFs in new transmission lines and locating the lines away from schools, hospitals and playgrounds; and encouraging companies with EMF-generating equipment to form groups to monitor research and meet with customers and community officials. "The utility with a program that includes a reasonable response to what is presently known will decrease its risk of future liability," Hanzlik writes in his paper, "Electric and Magnetic Field Litigation—Thinking Beyond Today's Challenges," which he presented at a March 9-10 conference sponsored by *Transmission & Distribution* in Arlington, VA.

NERP Pushes Ahead Despite Funding Uncertainties

The National EMF Research Program (NERP) is moving forward despite uncertainty about funding sources and the support of government agencies.

At its March 24-25 meeting in Arlington, VA, the NERP steering committee decided to issue a request for proposals (RFP) this summer for a research administrator and to begin research by January 1, 1993.

"We're in a very fluid situation," said NERP Chairman John Coughlin, referring to the possibility that pending congressional legislation may siphon funding from the NERP. Like the NERP, the legislation would set up a long-term research program funded by federal, state and private sponsors (see p.1 and *MWN*, N/D 91 and J/F92).

Anne Strauss of the New York Power Authority (NYPA), which has been the primary utility industry supporter of the public–private approach, said in an interview that industry does not want to contribute to more than one national program. NYPA is a member of an informal group of potential private sector sponsors that NERP officials call the "significant contributors group."

The DOE and the Environmental Protection Agency (EPA) also plan to fund EMF research, and it is not clear how their plans will mesh with the NERP's. The DOE has asked Congress for $7.5 million for the fiscal year that begins on October 1, 1992. It is in the process of formulating an EMF research program for federal and state agencies and private companies.

EPA currently has $1.94 million for EMF research. It has not decided whether to spend it on research by agency scientists, allocate it according to DOE's plan, contribute it to a federal–state program such as the NERP or give it to a private research organization such as the Health Effects Institute (HEI) of Cambridge, MA (see p.2). A decision is expected soon, according to agency sources.

Working in their favor, steering committee members say, is NERP's ability to begin research and produce results faster than the pending congressional program could. Energetics Inc. of Columbia, MD, which is providing staff support to the NERP, estimates that the bill would require at least 20 months of planning before research would begin.

At its March meeting, the steering committee introduced two new members and announced one member's resignation. The addition of David Kleffman, deputy director of EPA's Office of Health Research, makes EPA the first federal agency to join the NERP. The utility contributors had considered the lack of federal participation a major drawback, NERP sources say. Coughlin hopes to add at least one more federal representative. Wendell Holland, a public utility commissioner from Pennsylvania, has also joined the steering committee.

Dr. Mark Cooper of the Consumer Federation of America (CFA) has resigned. Sources involved with the NERP told *Microwave News* that Cooper withdrew after the American

Public Power Association (APPA) and the National Rural Electric Cooperative Association (NRECA), both of which are members of the CFA, questioned its involvement with the NERP. The CFA decided independently to have Cooper resign, the sources said. Cooper did not return calls for comment.

The steering committee plans to add a member from a national environmental or consumer organization. It also is considering adding a representative of the Electric Power Research Institute (EPRI), at the urging of steering committee member Dr. Charles Imbrecht, a California energy commissioner. But Coughlin said that he has already met with EPRI officials and he does not think they want to join the NERP.

In its effort to issue an RFP, the committee directed Energetics to propose, by May 1, an organizational structure, a job description for the research administrator, a conflict of interest policy and bylaws. Energetics was also asked to incorporate the NERP as a nonprofit organization.

The steering committee will next meet this summer, when it hopes to finish the RFP.

Major New U.K. Epi Study

On April 1, the U.K.'s Coordinating Committee for Cancer Research (CCCR) will start a large-scale epidemiological study in an effort to determine the causes of childhood cancer, with the possible role of electromagnetic fields (EMFs) among the hypotheses tested.

The five-year, £6 million (about $10.4 million) effort will be run by a management committee chaired by Sir Richard Doll, an epidemiologist at the Imperial Cancer Research Fund in Oxford. "This very important study is the largest and most wide-ranging to be carried out anywhere in the world," said Professor Dame Margaret Warwick, the chairwoman of the CCCR.

The families of all children under 15 newly diagnosed with cancer in England and Wales will be approached for the case–control study. Over the course of the study, the CCCR expects to investigate 1,000 cases of acute lymphoblastic leukemia—the most common type of childhood cancer—and 3,000 cases

State EMF Actions

Connecticut...A task force created by the Connecticut legislature last July has decided that adopting a policy of prudent avoidance of EMFs would be premature. The group, cochaired by representatives of the Departments of Environmental Protection and Health Services, wrote in its interim report, issued in February, that the state should not rule out "an association between EMFs and health risks and...the subject needs more investigation." The task force is hiring a consultant to conduct a literature review. Its final report is due by October (see *MWN*, M/J91 and J/A91).

Illinois...A bill requiring a three-year moratorium on the construction of power lines carrying more than 60 kV was introduced into the House on February 13 by Rep. John Matijevich. HB 2775 would also require the Illinois Commerce Commission to conduct a study of the effects of EMFs on health and to submit a report to the legislature before January 1995. The measure states that power lines greater than 60 kV could be repaired and rebuilt as long as the modifications didn't increase capacity. The bill is pending in the House Rules Committee. Senate sponsors have not been named....Another bill with a similar three-year moratorium was introduced by Rep. Suzanne Deuchler on March 4. HB 2863 would require the Department of Energy and Natural Resources to conduct a study on the health effects of EMFs. The measure—which was assigned to the House Environment and Energy Committee on March 25—would require a report to the legislature by January 1994.

Indiana...An EMF bill introduced by Senator Robert Meeks passed the Senate on January 27 but died two days later after it was moved to the House Committee on Rules and Legislative Procedures. SB 223 would have required the Utility Regulatory Commission to study scientific literature about the health effects of EMFs and to establish EMF safety requirements with regard to transmission lines.

New York...An EMF bill introduced by Assemblyman Maurice Hinchey is awaiting a hearing in the Committee on Environmental Conservation after being returned there by the Ways and Means Committee in January. AB 4657 would authorize the Department of Environmental Conservation (DEC) to regulate EMFs. The measure also recommends EMF exposure limits along ROW edges: for example, 150 mG for a transmission line of no more than 230 kV and 200 mG for a 500 kV line. The DEC would be required to review literature on the health effects of EMFs and to submit a report to the governor and the legislature by January 1993. New York already follows standards set by the Public Service Commission (see *MWN*, S/O90).

Pennsylvania...HB 2273, introduced by Rep. Patricia Carone, would authorize the Public Utility Commission (PUC) to develop an EMF avoidance program to reduce public exposure to EMFs from power lines. The program would be based on the concept of prudent avoidance. The measure, introduced last December 10, awaits a hearing in the conservation committee. It would authorize the PUC to adopt standards for maximum EMFs at ROWs. In addition, the PUC would collect a power line siting fee from any public utility authorized to build a transmission line.

Wisconsin...AB 698, which would require a survey of the location of transmission lines in relation to schools and other public facilities, was passed by the Assembly on March 11. Introduced by Rep. Maxine Hough last November, the bill originally called for a moratorium on the construction of new lines of at least 60 kV. This requirement was later deleted. "Even though the final bill is much reduced from the original language, it's a great victory," said Paulette Quick, legislative aide to Hough. "A survey is the most minor action you can take, yet it received tremendous opposition from utilities and individuals." The legislation still must be passed by the Senate and then signed by the governor. The Wisconsin Public Service Commission decided in January that state utilities must use the best available control technology to reduce EMFs from new and upgraded transmission lines; however, it rejected a citizens group proposal for a three-year moratorium on new lines of at least 60 kV (see *MWN*, J/F92).

of other types of cancer. A similar study among Scottish children began a year ago.

Along with EMFs, four other possible risk factors will be investigated. They are: ionizing radiation (exposure both in utero and after birth); carcinogenic chemicals and drugs; damage to the father's sperm by chemicals or ionizing radiation; and infectious agents.

A large-scale study of childhood cancer is already under way at the National Cancer Institute (NCI) in the U.S. (see *MWN*, J/F89). It should be completed by 1995, according to NCI's Dr. Martha Linet. The possible EMF–childhood cancer link is also being studied in Australia (see *MWN*, J/A91).

A previous U.K. study on power line EMFs and childhood cancer failed to show any association, but few of the participants were, in fact, exposed: more than 95% of the cases' and controls' homes had calculated magnetic fields of less than 0.1 mG (see *MWN*, J/F91).

Doll is also the chairman of an advisory group that reviewed the status of EMF research for the National Radiological Protection Board and that formulated priorities for future study (see p.9).

California Group Reaches Limited Agreement

California EMF Consensus Group members were unanimous in their basic belief that "society can no longer ignore the warnings that electromagnetic fields [EMFs] are a potential problem," according to a March 20 report. Although the group's 17 members—who represent diverse interests including utilities, labor unions and citizens groups—recommended that the California Public Utilities Commission (PUC) adopt research, education and mitigation policies, they could not always agree on how these requests should be implemented. The consensus group was charged in October 1991 with developing recommendations on interim EMF policies for the PUC.

First among the consensus group's policy recommendations was that the PUC adopt an interim plan that permits utilities to take no-cost or low-cost steps to reduce EMFs. There was no consensus on how to define "low-cost" mitigation, however.

In the field of research, recommendations for state and national EMF research programs were restrained by members' inability to agree on funding levels for the programs.

Although the consensus group recommended an EMF education plan for electric utility personnel and customers, the members could not agree on how much more should be spent than the $3 million California electric utilities now contribute annually to EMF education programs, and on who should pay to implement the plan.

The consensus group also recommended that the commission ask electric utilities to consider public concerns about EMFs when siting new facilities, and, at the same time, proposed that the public take action to protect itself—for example, by adopting a policy of prudent avoidance. The PUC must decide if it wants to hold formal hearings and adopt the recommendations.

For a copy of the report, *Issues and Recommendations for Interim Response and Policy Addressing Power Frequency Electric and Magnetic Fields*, contact: CA PUC, CACD-Environmental Section, 505 Van Ness Ave., San Francisco, CA 94102, (415) 703-2523. (For more on the consensus group, see *MWN*, N/D91.)

HIGHLIGHTS

Testicular Cancer Cluster Among Police Radar Users

Seven officers in two small Michigan police departments have been diagnosed with testicular cancer, and traffic radar is suspected as a possible cause. The two departments, in Grand Rapids and the nearby suburb of Wyoming, have 265 and 75 officers, respectively—and a total of about 200 patrol officers.

"This strikes me as very odd, very unusual," said Dr. Robert Davis, who is studying cancer rates among police officers in Washington State. "We shouldn't just dismiss it out of hand." He added that, "My gut feeling is that, given that we don't know what causes testicular cancer, radar is the common factor among these officers that is unusual."

Four officers in the Grand Rapids department developed testicular cancer over the last ten years—diagnosed in 1982, 1984, 1988 and 1991. Each of the first three had used hand-held radar units for over ten years prior to diagnosis, according to a series of interviews. The fourth had used radar for less than a year and only for a short time before his cancer was diagnosed.

In Wyoming, three officers developed testicular cancer. Two were diagnosed in 1979: one used hand-held radar for about five years, the other for more than ten years. The third officer was diagnosed last year; he had used hand-held radar for six months in a previous job in the early 1980s and had used dashboard-mounted radar more recently for two-and-a-half years in Wyoming.

Davis, of the division of general pediatrics at the University of Washington Medical Center in Seattle, explained that to quantify the possible link between the testicular cancer cases and radar use, he would count only six of these cases. He would include the most recent Wyoming case, but he called it "questionable," since the officer's exposure to hand-held radar was limited. He said the Grand Rapids officer diagnosed most recently apparently was not exposed to radar long enough prior to diagnosis to be considered.

There are at least two other cases not included in the cluster: