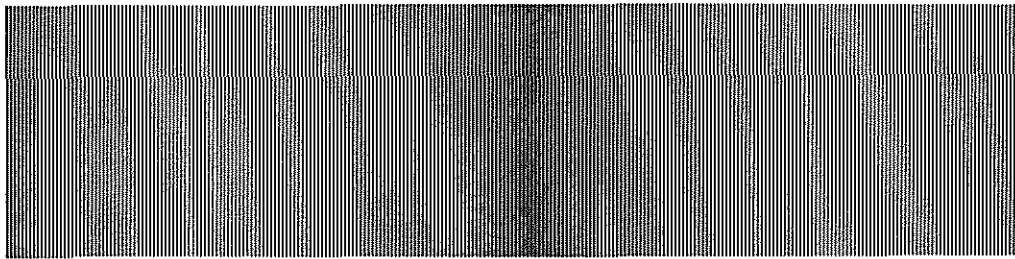


MICRO WAVE NEWS



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A Report on Non-Ionizing Radiation

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Epidemiologists Call for Study of EMFs and Female Breast Cancer

Health experts are now placing a high priority on a study of the possible link between female breast cancer and exposures to electromagnetic fields (EMFs). The consensus emerged following the publication of a third report indicating an excess of male breast cancer among EMF-exposed workers.

At a January 30-31 workshop sponsored by the National Institute for Occupational Safety and Health (NIOSH), a panel of epidemiologists added female breast cancer to leukemia, brain tumors and lymphoma as critical targets for future EMF research. NIOSH's *Scientific Workshop on the Health Effects of Electromagnetic Radiation on Workers* was held in Cincinnati, OH.

In a series of interviews with *Microwave News*, workshop panelists and

EPA Cancer Report Update: SAB Meets, Congress Keeps Tabs, U.K. Sets Review and Excerpts from Testimony; see pp.6-10.

participants expressed almost unanimous support for the new initiative. "I think we should study female breast cancer and EMFs," said Dr. Genevieve Matanoski of the Johns Hopkins University School of Public Health in Baltimore, MD. Similarly, Dr. Samuel Milham of the Washington State Department of Health in Olympia said, "It's time to study female breast cancer vis-à-vis EMFs—absolutely."

Dr. Gilles Thériault of McGill University in Montreal, Canada, the work-

(continued on p.14)

USC Leukemia Study Supports Denver Wire Code Risks

On February 7, Dr. John Peters of the University of Southern California (USC) presented preliminary results showing a statistically significant association between childhood leukemia in Los Angeles, CA, and wire codes—surrogates for electromagnetic field exposures. The results support previous findings of a wire code-childhood cancer link by Dr. Nancy Wertheimer and Ed Leeper and by Dr. David Savitz.

The data offer "little support" for a link between measured magnetic field exposures and leukemia risk, "some support" for a link to wiring configurations and "considerable support" for a link to children's electrical appliance use, according to a USC statement released by the Electric Power Research Institute (EPRI)—the sponsor of the study. Peters reported the results at an EPRI workshop in Carmel, CA (see p.14).

Peters has declined to comment on the study at this time. The results should be published within four months, according to EPRI. The announcement was made as we go to press; full details in our next issue.

« Power Line Talk »

Reports of soaring cancer rates are continuing to appear. On January 29, the American Cancer Society (ACS) announced that the breast cancer risk for women in the U.S. has risen to one in nine—up from one in ten in 1987. The ACS estimates that this year 175,000 American women will develop breast cancer. *Time* magazine ran an eight-page cover story on breast cancer in its January 14 issue with provocative headlines such as “A Puzzling Plague.” The trend is not limited to the U.S.: “There is an epidemic of breast cancer, which...appears to be occurring around the globe,” Germany’s Dr. Lenore Kohlmeier and colleagues conclude in a paper recently published by the New York Academy of Sciences (NYAS) in *Trends in Cancer Mortality in Industrial Countries*. While many researchers suggest that improved detection and the aging of the population may be partly responsible for the higher rates, most agree that there is more to the story. “Something in our environment is contributing,” Dr. Marc Lippman of Georgetown University told *Time*. The risk of brain tumors is on the rise as well—and not just among the elderly. Dr. Devra Lee Davis of the National Research Council, one of the editors of the NYAS collection, told the December 11 *New York Times* that the rate of brain cancer among people under 45 increased about 2% each year between 1973 and 1986. Davis noted that some researchers have implicated EMF exposure as a possible brain tumor risk. Davis’s results will appear in the April 1991 issue of the *American Journal of Industrial Medicine*. Last August, Davis and colleagues reported a sharp rise in brain and central nervous system cancers among the elderly in the U.S., Japan and four European countries over the past 20 years (see *MWN*, S/O90). And NIH’s Dr. Nigel Greig reported in the October 17 issue of the *Journal of the National Cancer Institute* that primary malignant brain tumor incidence among the elderly “increased dramatically” between 1973 and 1985.... All of this appears to have been missed in the executive suites at EPA—hard though it is to imagine after the headline on the front page of the December 10 *Washington Post*: “Cancer Rates in Industrial Countries Rise.” Dr. William Farland, the EPA official who deleted the “probable-human carcinogen” designation from the agency’s EMF cancer assessment (see *MWN*, M/J90), told the December 15 *New York Times* that it is clear that an EMF-cancer relationship cannot be too large, because the records of disease in this century do not show notable increases as the country was electrified.

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The DOE’s EMF bioeffects research budget will increase in fiscal year 1992, according to Dr. Imre Gyuk, the agency’s program manager. The DOE asked for \$5 million, which was approved by the Office of Management and Budget. In the last few years, the budget has been steady at about \$3 million (see *MWN*, S/O89). When asked what he would do with the new money, Gyuk replied that he would “flesh out” some of the existing projects which had been “cut to the bone” and also develop some new requests for proposals. The final amount of

the increase is now up to Congress.

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In Rhode Island, a local moratorium on power lines might soon apply to the whole state. Last October, responding to widespread public concern over the health effects of EMFs, the East Greenwich town council banned all new power lines above 60 kV for three years (see *MWN*, N/D90). In early January, two bills modeled after the East Greenwich ordinance were introduced in the state legislature by Senator Michael Lenihan and by Rep. John Hernandez, both Democrats. If the bills become law, they will impose the three-year moratorium statewide. The Narragansett Electric Company is appealing the East Greenwich action to the Rhode Island Public Utilities Commission (PUC), but this will become moot if the bills are adopted as state law. Amato DeLuca, a Providence-based attorney and the author of the East Greenwich ordinance, told *Microwave News*. According to DeLuca, public opinion in Rhode Island is behind the bills, which have “a decent shot at passing.”

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Wisconsin state legislators are less than eager to go to work since EMFs higher than 100 mG were found in their office building. The levels were detected when workers in one office on the second floor noticed that their video display terminals (VDTs) were behaving erratically. Madison Gas & Electric (MG&E) took measurements in the building and found levels as high as 400 mG near the transformer room directly below on the first floor. MG&E brought the levels down to an average of 25-125 mG in some areas by reconfiguring lines and redesigning the electrical vault, but legislators and their staffs are still concerned, according to Katie McGrath, an aide to state Rep. Tom Seery, who is in charge of the EMF investigation. “People are a little frightened. We’ve got pregnant women in this building,” McGrath told *Microwave News*. Although the initial measurements were taken last spring, most of those working in the building didn’t learn about them until a local paper ran the story. Now no one wants to move into the building and those already there have turned down spacious offices with high EMF readings, McGrath said. She added that some legislators have become interested in pursuing state health-based exposure guidelines: “If it hadn’t affected the legislative arena, we wouldn’t be getting this much attention this fast.”

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The Northeast Public Power Association (NPPA) is encouraging member utilities to communicate more with the public about the EMF controversy. “Do not deny the issue,” NPPA’s EMF task force urges in a list of guidelines for utilities planning to establish EMF policies. The NPPA recommends acknowledging public concerns and sharing information with customers and the media. The guidelines also advise: “Consider proce-

dures for minimizing potential EMF exposure when siting, designing and operating power facilities.”

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On January 15, the California Public Utilities Commission (PUC) announced that it will investigate how it should address the issue of EMF health effects. The PUC identified four possible strategies: taking no action, maintaining the status quo while

limiting any increase in exposure, instituting “prudent avoidance” and aggressively limiting exposures. Utilities and other interested parties have been requested to submit comments by March 15. Public hearings are also planned. In 1988, the PUC, in conjunction with the state Department of Health Services, launched a state-ordered, \$2 million research project on the potential effects of EMFs (see *MWN*, M/J88, S/O88 and J/A89).

EMF Mitigation Projects Gain Momentum

The Electric Power Research Institute (EPRI) has allocated \$1 million to study ways of reducing electromagnetic field (EMF) exposures. *Studies of Magnetic Field Management*—one of the most ambitious mitigation efforts planned to date—will identify shielding and grounding systems, as well as the most common sources of EMF exposure, Greg Rauch, who is managing the project for EPRI’s Electrical Systems Division, told *Microwave News*.

Other mitigation projects are under way in Sweden and in at least three U.S. states.

Among the mitigation techniques to be investigated by EPRI are:

•*Low-field transmission line configurations*: Including reverse phase, split phase, delta and compact configurations. Tests have already shown that these designs can achieve some field cancellation (see *MWN*, J/F89), but problems, such as increased corona discharge and the need for tower design modifications, remain.

•*Line burial*: Substantial field cancellation can result when the three-phase conductors of transmission lines are very closely spaced within an underground, oil-filled, steel pipe. Cancellation is less efficient for buried, residential, single-phase, primary distribution lines and these lines may cause public exposures.

•*Return current “roundup”*: Neutral return currents are often found on water pipes or other conductors in buildings and can cause current imbalances and contribute significantly to background EMF levels.

•*Ferromagnetic shielding*: Ferromagnetic materials can attenuate magnetic fields. Use of this type of shielding would probably be limited to utility workers and others who must spend significant periods of time exposed to high levels of EMFs in the workplace.

•*Robotic equipment*: EPRI has already developed a robotic remote manipulator arm for working on overhead transmission lines and could develop similar equipment for other types of high exposure work.

These approaches have emerged over the last year. For example, utility representatives, EPRI staffers and contractors reviewed them at an April 1990 workshop in Orlando, FL. Much of the research will be conducted at EPRI’s High-Voltage Transmission Research Center in Lenox, MA.

A 15-page article in the October/November 1990 *EPRI*

Journal illustrates a number of field reduction techniques. In an accompanying editorial, Dr. Narain Hingorani, the vice president of EPRI’s Electrical Systems Division, writes that EPRI’s mitigation efforts are in response to public concern about possible health effects, which is “creating pressure and expectation for measures to reduce or eliminate such fields before a scientific understanding of the nature and magnitude of the risk is in hand.”

EPRI will be coordinating its efforts with the Empire State Electric Energy Research Corporation (ESEERCO), a consortium of New York utilities. In January 1991, ESEERCO announced that it will sponsor two mitigation projects with \$200,000 of its own funds and \$100,000 from EPRI. A contract has been signed with the IIT Research Institute (IITRI) in Chicago, IL, to compile a catalogue of exposure sources. And negotiations are under way with Professor Stewart Maurer of the New York Institute of Technology in New York City for a ten-month, \$95,000 study of ground currents; Maurer would investigate possible changes in grounding regulations and design diagnostic models to identify sources of ground currents and help reduce residential EMF exposures. In the second phase of its effort, ESEERCO will develop the most promising EMF mitigation techniques.

The ESEERCO effort was prompted by the New York Public Service Commission (PSC), which has urged state utilities to conduct a large-scale EMF survey and investigate ways of reducing exposures (see *MWN*, M/A88, M/J88 and J/A89).

Separate mitigation studies are also under way in Florida and in Washington State. Last year, the Florida Environmental Regulatory Commission appointed an independent task force to oversee a two-year, \$1 million survey of EMF reduction options (see *MWN*, M/J90). The project, which is being funded by the Florida Electric Power Coordinating Group and administered by the state Department of Environmental Regulation (DER), is an outgrowth of the state’s 1989 magnetic field rules proceedings (see *MWN*, M/A89). The DER issued a request for proposals, No.9113, on February 8.

In Washington, the Department of Health is conducting a two-year, \$40,000 investigation into the feasibility of mitigation. The project was mandated by a state law enacted in March 1990 (see *MWN*, M/J90).

The Swedish State Power Board (SSPB) is also sponsoring work on mitigation. In a paper, *Reduction of Transmission Line Magnetic Fields—Possibilities and Constraints*, presented at

the August-September 1990 meeting of the Conference Internationale des Grands Réseaux Électriques (CIGRÉ) in Paris, France, SSPB researchers concluded that decreased reliability makes compact configurations impractical over long sections of a line, but that significant field reductions can be achieved using delta and reverse phase configurations. The researchers also investigated the possibility of inducing shield currents on extra wires to cancel fields and found that this type of shielding promises considerable EMF reductions.

NCI EMF Witnesses Get Light Reprimand for Misconduct

Three National Cancer Institute (NCI) staff scientists who were paid to testify at the 1988 Marcy-South power line trial violated National Institutes of Health (NIH) outside income rules, an NIH internal investigation has concluded.

In an October 1989 memo, NIH investigators recommended that the matter be referred to the director of the NCI for "appropriate action." The memo was released to *Microwave News* following a long series of Freedom of Information Act (FOIA) requests first initiated in 1989.

The NIH has repeatedly refused to disclose what action has been taken, citing "a clearly unwarranted invasion of personal privacy." However, a knowledgeable source revealed that the punitive action was "minimal and retroactive"—a temporary ban on outside consulting which was lifted when the investigation was completed.

Recently, rumors have been circulating that the NIH has adopted an unofficial policy barring staff members from receiving income for consulting on electromagnetic field (EMF) issues. The rumors could not be confirmed, however.

In 1987 and 1988, NCI staffers Drs. Stuart Aaronson, Lucius Sinks and Margaret Tucker received \$70,250.98, \$41,083.42 and \$12,978.04, respectively, from Crowell & Moring, a Washington, DC, law firm, for testifying on behalf of the New York Power Authority (see *MWN*, S/O88, N/D88 and J/F89). Crowell & Moring handled the bioeffects portion of the Marcy-South litigation for the New York Power Authority.

According to the memo, the director of the NIH's Division of Management Survey and Review (DMSR) found that Aaronson and Sinks earned more than the amounts stated on their approved requests for outside activity. Tucker and Sinks were found to have been paid for work performed outside the period approved by the NCI—in Sinks's case, the unauthorized fee was substantial. In 1989, Sinks told Jeffrey Mervis of *The Scientist* that NIH rules on outside income are cumbersome and do not serve the public interest (see *MWN*, S/O89).

Aaronson and Tucker refused to comment. Sinks, who left the NCI in August 1989 and is now at Middlesex Memorial Hospital in Middletown, CT, did not return telephone calls.

When asked if the NCI staffers would testify in future power line cases, Crowell & Moring's Tom Watson told *Microwave News*, "I would have no hesitation using them. They're out-

U.K. Study: No EMF-Childhood Cancer Link Below 1 mG

There was no association between the risk of childhood cancer and either the proximity of overhead power lines or calculated magnetic fields, according to a new report by Dr. A.D. Clayden and colleagues at the U.K.'s University of Leeds. "The study reveals little about possible effects of magnetic fields *per se*," the team concluded, however, since more than 95% of the case and control addresses had calculated fields of less than 0.1 mG. Indeed, the assumed background level was 0.1 mG.

The team further noted that, "The study stood no realistic chance of detecting any raised relative risk associated with a field of more than 1 mG, because of the very small numbers of cases and controls in that situation." In fact, only one case and four controls were exposed to over 1 mG.

This is one of the first of the more than 22 major epidemiological studies of EMFs and cancer under way worldwide to report results (see *MWN*, N/D89). Unlike the majority of the other studies, there are no direct measurements of magnetic field strengths, only calculations based on line-network maps and load records. "Weaknesses of the study include the lack of any measurements of magnetic fields at case or control addresses," the team pointed out, adding that direct measurements were ruled out for "ethical reasons."

The study included 374 cases of childhood cancer diagnosed in Yorkshire between 1970 and 1979 and 588 controls.

Preliminary results were first presented by Dr. A. Myers at the *International Conference on Electric and Magnetic Fields in Medicine and Biology* in London, December 4-5, 1985. Among the other authors is Dr. Ray Cartwright who, in an editorial in the *British Journal of Cancer*, 60, pp.649-651, 1989, wrote that EMF exposure risks are "minute...verging on the point of nonexistence" (see *MWN*, J/F90). The new study appeared in the *British Journal of Cancer*, 62, pp.1008-1014, 1990.

standing scientists." Nevertheless, the firm has assembled a new group of expert witnesses who recently spoke on behalf of the Utility Health Sciences Group, which was organized by Crowell & Moring (see p.7 and pp.8-10).

The investigation was handled delicately because Aaronson is one of the top researchers at the NIH. He was listed as one of the institute's ten most-cited scientists of the 1980s in the June 25, 1990 issue of *The Scientist*. At the top of the list was NCI's Dr. Robert Gallo. In December 1989, Representative John Dingell (D-MI), who was investigating alleged misconduct by Gallo in the discovery of the AIDS virus, accused the NIH of repeatedly "[turning] a blind eye to misconduct by senior scientists..." Dingell's investigation was prompted by a November 1989 exposé on Gallo by *Chicago Tribune* reporter John Crewdson. Crewdson has also filed FOIA requests with the NIH

for information on Aaronson, Sinks and Tucker concerning outside income violations.

NIH outside income rules revised in September 1988 bar staff members from receiving more than \$25,000 a year in outside income from profit-making organizations and from earning more than \$12,500 from any one company or law firm. Because the revisions were made when the NCI staffers were already consultants to Crowell & Moring, the DMSR limited the inquiry to whether the staffers had misrepresented the fees they anticipated when requesting approval for outside income.

The following is a brief account of the staff members' violations as related in the NIH memo:

- Aaronson received approval for outside income "not to exceed \$25,000" for the period February–December 1988. In 1988, Crowell & Moring paid him \$51,875 in fees alone—more than double the approved amount.
- Sinks was paid \$10,500 by Crowell & Moring for the last three months of 1987, but he never requested official approval. When asked why he had not submitted a request, he told investigators

that it would have taken eight weeks to obtain approval and he was already involved in the case. Sinks did submit a request for "an anticipated fee of \$4,000" for the first half of 1988; he earned \$29,500 in fees during that period. The DMSR found that, "Sinks clearly violated the conditions governing outside work activities of NIH employees...he received \$40,000 in fees even though he received approval to earn \$4,000."

• The DMSR concluded that Tucker, for the most part, did not violate outside income rules—except that she began working for Crowell & Moring prior to the period for which she received authorization. The NIH did not investigate the other instances in which Tucker was a Crowell & Moring paid expert witness—in 1988, Tucker testified for at least four other utilities around the country (see *MWN*, J/F89).

The issue of misconduct was originally raised by Dr. Ross Adey of the VA Hospital in Loma Linda, CA, in a December 29, 1988 letter to the director of the NIH following the publication of the Marcy–South expert witness fees in the November/December 1988 issue of *Microwave News*.

New from EPRI

The following reports have been published by the Electric Power Research Institute (EPRI). Copies of the reports marked with an asterisk (*) are available from: Research Reports Center, Box 50490, Palo Alto, CA 94303, (415) 965-4081. Those marked with a dagger (†) can be obtained by calling the EPRI "straight line": (415) 934-4212.

*A.A. Afifi et al., *Proceedings: Discussion of an EMF Protocol* (EN-6829, Project 2964-6), July 1990. Price: \$25.00 (\$50.00 overseas). In this report, prepared by Robert S. Banks Associates, Inc. of Minneapolis, MN, the authors argue that the ambiguous findings of many studies of EMF health effects could be clarified by developing an improved protocol for EMF exposure assessment. They summarize the conclusions of epidemiologists and exposure assessment experts who participated in a three-day forum in early 1989: Though there was extensive examination of EMF exposure measurements, no consensus was reached on a single protocol.

*Dan Bracken, *The EMDEX Project: Technology Transfer and Occupational Measurements* (EN-7048), November 1990. Price: Vol.1 \$25.00; Vol.2 \$32.50; Vol.3 \$47.50 (\$50.00, \$65.00 and \$95.00 respectively, overseas). Preliminary results indicate general satisfaction with EPRI's EMDEX EMF measurement system. EMDEX is a microcomputer-based digital meter that monitors and records EMF exposures. The project's 50,000 hours worth of exposure data—the most extensive documentation of exposures among utility employees ever—has not yet been fully analyzed.

*D. Briskin and J.S. Feher, *Research and Development in the 1980s: An Overview* (OCSP-6894), June 1990. Price: \$25.00 (\$50.00 overseas). A summary of trends in overall spending on research and development, both nationally and internationally, with an emphasis on developments in the electric utility industry.

†*The Cyclotron Resonance Hypothesis: An EMF Health Effects Resource Paper* (EN.3014.3.90), March 1990. Single copies are free. A descriptive and mathematical exploration of cyclotron resonance, which has been advanced—most notably by Dr. Abe Liboff—as a possible mechanism of interaction for observed EMF biological effects. This pamphlet details the physical nature of cyclotron resonance, its effectiveness in explaining laboratory results and the experimental and theoretical problems which impede its general acceptance.

†*Health Effects of High-Voltage Direct Current [HVDC] Transmission Lines: An Environmental Briefing* (EN.3013.3.90), March 1990. Single copies are free. HVDC power lines are a cost-effective and safe way to transport electricity over long distances, according to EPRI, which argues that biological and behavioral research failed to indicate harm to humans or animals "even when exposure levels were much greater than those found within DC transmission line rights-of-way." The report concludes that further research into this area should be given a low priority, while research into the health effects from alternating current (AC) power lines should continue.

*J. Kadvanly and L. Merkhofer, *A Handbook for Communicating Potential EMF Risks* (EN-7046), Interim Report, October 1990. Price: \$32.50 (\$65.00 overseas). Designed to help utility personnel respond to the growing number of public inquiries about EMF health risks. According to the authors, prerequisites for using the handbook include a well-defined utility position on EMFs and one or more individuals with a sound knowledge of the issue. A revised edition with more extensive scientific and risk communication information will be issued later this year.

*R. Kavet and J.M. Silva, *An Alternative Hypothesis for Association Between Distribution Wiring Configurations and Cancer: Planning Phase* (EN-6863), June 1990. Price: \$25.00 (\$50.00 overseas). The authors propose that elevated cancer risk among children living near high-current power lines might be due to an increase in carcinogens in drinking water caused by pipe corrosion, and they suggest that "the same external wire configurations that generate higher magnetic fields also lead to larger currents in water pipes used as grounds and thus result in accelerated pipe corrosion...." The report includes some strategies for testing this hypothesis.

**1989 Annual Report: EMF Health Effects Research Abstracts* (EN-7066), May 1990. Single copies are free. The first annual report on EPRI's EMF program. It includes a statement on each of the

ongoing research projects.

1990 EPRI Utility Seminar: New EMF Epidemiologic Results & Their Implications, 1991. Price: \$50.00 for EPRI utilities, government agencies, universities and nonprofit groups; \$250.00 for others (air mail postage extra). Order from: Robert S. Banks Associates, Inc., PO

Box 14574, Minneapolis, MN 55414. Proceedings of the EPRI-sponsored seminar, held October 15-19, 1990 in Austin, TX. Includes summaries of EMF research at USC and JHU, as well as transcripts of presentations and panel discussions. Also includes tutorials on epidemiology and exposure assessment.

HIGHLIGHTS

Utility Witnesses Fail To Sway SAB Panel at Public Meeting on EPA Cancer Report

Witnesses representing the utility and electronics industries were sharply critical of the Environmental Protection Agency's (EPA) draft report on the cancer threat from electromagnetic fields (EMFs). The industry testimony, presented at a public meeting in Washington, DC, January 14-16, did not appear to convince EPA's Science Advisory Board (SAB) panel charged with reviewing the report. Citizens' groups, on the other hand, supported the EPA effort and encouraged the SAB to back more research on EMF bioeffects. (Excerpts from the statements to the SAB are on pp.8-10.)

The report, which was released December 14, identified EMFs as "a possible, but not proven, cause of cancer in humans" (see *MWN*, N/D90).

While the members of the SAB's EMF panel were reluctant to give their own assessments—preferring to let the panel's final report speak for itself—many expressed their frustrations at the one-sided nature of the industry statements. Despite these critiques, the panelists had a favorable view of EPA's review of the epidemiological data. They were less impressed with the chapter on mechanisms of interactions, however.

"The epidemiological chapter is very complete with respect to the published papers," Dr. Patricia Buffler of the University of Texas Health Science Center said, but added that she would like to see more discussion of classification of exposures. Dr.

Genevieve Matanoski of the Johns Hopkins University School of Public Health, who is chairing the panel, agreed, saying that the chapter was "pretty good."

On the other hand, Drs. Granger Morgan of Carnegie Mellon University and Richard Wilson of Harvard University both criticized EPA's review of mechanisms. "I don't think this is a good enough literature review," Wilson said.

After the meeting, EPA's Dr. Robert McGaughy, the project manager for the report, told *Microwave News* that, "There's a lot of rewriting and explaining to be done. We will be more explicit about the uncertainties and that could change the tone of the report." Overall, he said, "I've not heard anything at the meeting to materially change the conclusions of the report."

The panel focused much of its attention on the testimony of the witnesses assembled by the Utility Health Sciences Group, representing more than 85 utilities. The group is being coordinated by Crowell & Moring, a Washington, DC, law firm. In their prepared statements, each—to a greater or lesser degree—discounted the link between EMFs and cancer, but their credibility suffered under questioning by the SAB panel members.

Dr. David Korn of Stanford University School of Medicine, who is also the chairman of the National Cancer Advisory Board, concluded that the data are "soft and noisy" and that the link between EMFs and cancer is "extraordinarily speculative." Following Korn's prepared statement, Drs. Craig Byus of the University of California, Riverside, and Bary Wilson of the Battelle Pacific Northwest Lab questioned him about specific studies. When Korn did not respond, Morgan asked whether he had read the key 20-30 papers on cellular and animal effects—Korn conceded that he had not.

Similarly, Dr. Mark Mandelkern of the University of California, Irvine, told the SAB panel that all the mechanisms of interaction were "implausible" and that "it's hard to understand this phenomenon," but he admitted under questioning that he was not familiar with the papers on EMF effects on melatonin production, which has emerged as a key focus of research interest. Bary Wilson and Morgan, this time joined by Dr. David Bates, the vice chairman of the panel, asked how he could address low-level effects when he did not know the literature. At one point, Mandelkern started to shuffle through his papers in an effort to respond. "How can you argue [your case] when you have to look up what you have read?" Morgan asked.

The absence of a clear mechanism did not lead the panelists

SAB EMF Panel

The members of the SAB's Non-Ionizing Electric and Magnetic Fields Subcommittee are: Dr. Genevieve Matanoski (Chair), Johns Hopkins University, Baltimore, MD; Dr. David Bates (Vice Chair), Vancouver, BC, Canada; Dr. Karim Ahmed, Princeton, NJ; Dr. Patricia Buffler, University of Texas, Houston; Dr. Craig Byus, University of California, Riverside; Dr. Kelly Clifton, University of Wisconsin, Madison; Dr. John DiGiovanni, M.D. Anderson Cancer Center, Smithville, TX; William Feero, Electric Research and Management, State College, PA; Dr. Robert Harris, University of North Carolina, Chapel Hill; Dr. Clark Heath, American Cancer Society, Atlanta, GA; Dr. Nan Laird, Harvard University, Boston, MA; Dr. Granger Morgan, Carnegie Mellon University, Pittsburgh, PA; Dr. Donald Pierce, Oregon State University, Corvallis; Dr. Mary Ellen O'Connor, University of Tulsa, OK; Dr. Charles Susskind, University of California, Berkeley; Dr. Bary Wilson, Battelle Pacific NW Lab, Richland, WA; and Dr. Richard Wilson, Harvard University, Cambridge, MA.

to discount the epidemiological results linking EMFs to cancer. "Lack of mechanisms is a valid criticism of the epidemiological data, but it does not mean we should throw it out," Bates told *Microwave News*. On the third day of the meeting, Bates expressed his frustration at many of those who had discounted the epidemiological studies. "I don't think many of the speakers had carefully read the epidemiological literature—including the U.S. Air Force." On the previous day, the Air Force had presented a blistering attack on the EPA report which was adapted from written comments submitted in October (see *MWN*, N/D90).

Dr. Dimitrios Trichopoulos, the chairman of the Department of Epidemiology at the Harvard University School of Public Health—another utility witness—was less dismissive, noting that causality is a "possibility." Nevertheless, he said that, according to his calculations, if there is a true link between EMFs and childhood cancer, given the electrification of the country over the course of the century, he would have expected an "epidemic" on the order of the one attributed to tobacco smoke. "We don't see it," he said. This prompted Matanoski to point out that there has been a consistent increase in childhood leukemia since the 1930s. She later told *Microwave News* that she thought that the assumptions upon which Trichopoulos based his analysis were "extreme." Dr. Donald Pierce of Oregon State University also said he was not swayed by Trichopoulos's reasoning.

In an interview after the meeting, Bary Wilson told *Microwave News* that the Utility Health Sciences Group witnesses "did not help their cause: They did not read the literature, they came with preconceived notions from their own areas of research and did not seem to consider important findings from other areas."

At the close of the meeting, the SAB panel members divided themselves into three groups to review specific portions of the document: physics and biophysics; epidemiology; and cell biology and mechanisms. The panel will meet again as a whole in April. Matanoski said that she plans to submit the panel's report in June.

Congress Keeps Tabs on EPA EMF-Cancer Report

Congress is actively monitoring the events surrounding the release of and the Science Advisory Board's (SAB) review of the Environmental Protection Agency's (EPA) draft *Evaluation of the Potential Carcinogenicity of Electromagnetic Fields*.

A number of members of the House of Representatives have criticized both the White House for its role in delaying the release of the report and the procedures set up by the SAB for its official review.

More than two weeks after the November 27 publication date, EPA had still not issued the draft report, due in large part to objections raised by President Bush's science advisor, Dr. Allan Bromley (see *MWN*, M/J90 and N/D90). After the White House's involvement was made public, the document was released on December 14, with an agency disclaimer added to

How To Order the EPA Report

Copies of EPA's draft report, *Evaluation of the Potential Carcinogenicity of Electromagnetic Fields* (EPA/600/6-90/005B), are available from: ORD Publications Office, CERL-FRN, U.S. EPA, 26 W. Martin Luther King Drive, Cincinnati, OH 45268, (513) 569-7562, FAX (513) 569-7566.

the front stating that "there are insufficient data to determine whether or not a cause and effect relationship exists" and that the "review draft should not be construed as representing agency policy or position."

In this interval, there were turbulent exchanges between Capitol Hill and EPA and the White House. In a December 11 letter to Bromley, Representatives George Brown (D-CA), chairman of the House Committee on Science, Space and Technology, James Scheuer (D-NY) and Frank Pallone (D-NJ) charged that Bromley's "unprecedented decision" to postpone the SAB review of the EPA report is "more likely to fan public concern than to allay it." Bromley, denying that he censored the document, responded on December 17 that his objections were rooted in the wording of the executive summary, which he claimed showed that the authors had determined that there is a causal relationship between EMFs and cancer.

Brown, Scheuer and Pallone also condemned the SAB for the manner in which the witnesses had been scheduled for the January 14-16 panel meeting. By the end of December, almost all of the slots for public comments had been assigned to speakers with ties to the utility industry. Four of the speakers represented the Utility Health Sciences Group, a coalition of more than 85 utilities "dedicated to promoting dialogue on EMF science issues" which was organized by the Washington, DC, law firm Crowell & Moring.

In a December 21 letter to EPA Administrator William Reilly, Brown, Scheuer and Pallone argued that "...the 'stacked deck' appearance of the presentations will destroy the very credibility of the SAB review process," and urged Reilly to "put an immediate halt to the practice of granting to interested parties the right to control who appears before the SAB." Pallone himself ultimately testified at the meeting before the SAB panel (see p.9).

Representative George Miller (D-CA), chairman of the House Interior Subcommittee on Water, Power and Offshore Energy Resources, scheduled a hearing for January 17 on the EPA report and the White House's involvement. "I want to know what the EPA found in its study. And...if Bush Administration officials in fact sought to manipulate the report's scientific findings for political purposes," Miller said. EPA's Erich Bretthauer, Dr. Richard Adamson of the National Cancer Institute and Eugene Wong, Bromley's assistant, were expected to testify, but the hearing was canceled at the last minute due to the Persian Gulf conflict. (For excerpts from their written statements, see pp.12-13.) At this time, there is no word when the hearing will be rescheduled.

Comments on the EPA EMF-Cancer Report

External Peer Review Panel

On June 28, 1990, a peer review panel met in Morrisville, NC, to discuss EPA's draft report on EMFs and cancer. The panel members were asked to consider, among other things, whether the document should contain a classification of cancer risk based on EPA's 1986 cancer risk guidelines (see MWN, M/J90). The following are excerpted from the panel members' written comments, which were submitted after the meeting. They were released to Microwave News under the Freedom of Information Act.

Dr. Larry Anderson, Battelle Pacific Northwest Lab (BPNL), Richland, WA: Overall the document is quite accurate as to current scientific understanding of the issues....Perhaps the major criticism of the document relates to the organizational mixing of ELF and RF study citations. Biological responses to exposure in varied frequency ranges may demonstrate marked differences....I concur with other members of the panel that it is yet too early to classify EMFs with respect to their carcinogenic potential. Certainly, it should not be designated with an A or B classification. However, sufficient evidence exists to suggest that further vigorous research is appropriate....It is especially important to expand the federal role in this area of research.

Dr. Richard Griesemer, National Toxicology Program, Research Triangle Park, NC: Among the research needs, one area that I think might deserve more attention is the possible effects of EMF exposure on gene expression.

Dr. Richard Luben, University of California, Riverside: [The executive summary] could point out more explicitly that the evidence associated with possible carcinogenicity of non-ionizing EMFs is difficult to classify using the EPA guidelines....[M]y own evaluation of the data is that the human studies provide limited evidence (i.e., suggestive but not conclusive) for the involvement of some component of EMF exposure in development of some human cancers. The animal evidence is clearly inadequate....The supportive evidence offers a number of plausible mechanistic scenarios for cancer induction or promotion, but is currently incomplete and thus inadequate. The above criteria would appear to fit into the category of a B1 carcinogen for EPA classification purposes.

Dr. Raymond Neutra, Department of Health Services, Berkeley, CA: Overall I thought [the document] was excellent....The EPA guidelines for chemical carcinogens hold for a set of agents which are acting by a familiar if not fully understood paradigm. They do not comfortably fit [EMFs]....Thus I agree with EPA that the guideline categories do not apply here and that a dose response assessment should not be made at this time.

Dr. Richard Phillips, WIL Associates, Spokane, WA: Using the weight of all evidence (human and animal data), there is limited evidence that exposure to ELF magnetic fields results in an increased incidence of cancer in humans....At present there are no data from laboratory animal studies. Such information does not really fit the EPA classification scheme that has been used for chemicals—the available data do not fit B1, B2 or C, but it is closest to B2....However, I believe it would be premature to classify the carcinogenicity of ELF magnetic fields at this time....In the interim, we direly need to initiate some lifetime exposures of experimental animals to low-level 60Hz magnetic fields, particularly for modeling leukemia, brain cancer and breast cancer.

Dr. Charles Poole, Epidemiology Resources, Inc., Chestnut Hill, MA: In my opinion...the deficiencies of the guidelines are serious enough to justify a decision not to classify the human evidence as either "inadequate" or "limited" at the present time. The classification decision should be deferred until the guidelines are improved or until the immense amount of ongoing research has been completed.

Dr. Asher Sheppard, VA Hospital, Loma Linda, CA (did not attend the meeting): The draft document presents the information that leads to the conclusions on epidemiological studies in a thorough, well-balanced and fair manner and the reasoning is logical, well-supported and persuasive. The discussions of *in vivo* and *in vitro* studies have many more difficulties....[C]oncerning the finding that it is inappropriate to classify the carcinogenic potential of fields because a mechanism is unknown, I found this argument unpersuasive....The lack of adequate mechanisms is a weak excuse that would be untenable in the face of strong epidemiological or clinical findings....In summary, I find the arguments specious, but share a reluctance to label the fields as carcinogenic on the basis of weak epidemiological data in the absence of mechanistic understanding. However, I would put aside my misgivings and I find it logical to label fields as "probable" human carcinogenic agents on the basis of the "weight of the evidence." Hence, I reluctantly disagree with the EPA draft position and strongly disagree with its arguments.

Dr. Richard Stevens, BPNL: In a number of places in the text [of the epidemiological section], it seems that the authors are biased in favor of the existence of an effect....I believe that given the current state of evidence, ELF should *not* be classified as B1. At most it should be classified as C, a possible human carcinogen.

Public Comments to the SAB Panel

On January 14–16, 1991, the SAB's Non-Ionizing Electric and Magnetic Fields Subcommittee held a public meeting in Washington, DC (see pp. 6-7). The following comments are excerpted from many of the written and oral statements presented at the meeting. Those who spoke before the SAB panel are marked with an asterisk (*). Those who appeared on behalf of the Utility Health Sciences Group are marked with a dagger (†).

***Dr. Eleanor Adair, John B. Pierce Lab, New Haven, CT:** Most of the epidemiological research is flawed and risk ratios are unpersuasively low....Further, in my view, the "weight of evidence" approach adopted in the document is inadmissible; no amount of mediocre data combined with other mediocre data will generate good or even believable data. I reject this method of analysis totally.

***Dr. Robert Adair, Yale University, New Haven, CT:** [The chapter on mechanisms of interaction is] not just bad science, it's crackpot science....[The recent work by the U.S.S.R.'s Dr. V.V. Lednev is] crackpot quantum mechanics.

Alexandrians for Safe Electric Power, Virginia citizens' group: [W]e ask for a response from the EPA's [SAB] to the following question...: Would they purchase a home for themselves and their families exposed to the level of ELF EMF readings in the eight-block area of Old Town [levels averaging 20–30 mG with a maximum of 100 mG]?

Dr. C.A.L. Bassett, Columbia University, New York, NY: [With a few exceptions, I] found [the document] to be a well-considered statement at this stage of our collective ignorance.

***Dr. John Bergeron, General Electric, Schenectady, NY:** If the EPA had chosen skepticism [on the calcium efflux experiments], then there would no longer be *any experimental basis at all for the belief that bioeffects including cancer promotion can be attributed to ambient fields*....I believe it would be in the public interest for the SAB to recommend to the agency that the highest priority laboratory research ought to be a project dedicated to resolving the dispute about calcium efflux.

***Mayor Jim Connors, Scranton, PA:** Our people want to know whether they should move [away from power lines]....There are a large number of people [here] representing industry....Who is representing the people?

***Richard Doherty, Electronic Engineering Times:** [U]ntil we establish better instrumentation, which can properly classify the true nature of the beast we suspect of generating harmful effects in living tissue, we are not performing science. We are instead hunting desperately for empirical evidence to support hypotheses while using imprecise and unhoneed instruments.

Richard Ekfelt, Electromagnetic Energy Policy Alliance, Washington, DC: Although our review has been limited in view of the short time schedule, we have uncovered sufficient evidence of misunderstandings of physical principles and sloppiness in composition of this draft so as to suggest that it does not meet minimum standards of science and scholarship.

***Dr. David Erwin, U.S. Air Force Armstrong Lab for Human Systems, Brooks AFB, TX:** In general, there is sufficient research being carried out in various laboratories commensurate with the urgency of the problem....Our reviewers of this document are convinced that there is no suggestion that EMFs present in the environment today induce or promote cancer.

***†Dr. Edward Gelmann, Georgetown University School of Medicine, Washington, DC:** Using any of the standard scientific criteria we apply to carcinogenesis, there is no support for the notion that power frequency electric and/or magnetic fields can induce or promote cancer or have any effect on tumor progression.

***David Goeller, Environmental Action, Washington, DC:** The government should be funding the search for these answers. The researchers and reviewers must be independent....The controversy will remain and grow until we get these answers. Are EMFs safe? Are they silent killers? The public has a right to know.

***Dr. Richard Griesemer, National Toxicology Program, Research Triangle Park, NC:** [The peer review panel found the] evidence is suggestive but inadequate—something less than 'B'....The whole field needs vigorous pursuit....Overall, we thought the study is well-balanced and reflects what is in the published literature.

Barbara Iannucci, Residents Against Giant Electric (RAGE), New Jersey citizens' group: [T]he body of the EPA release detailing suggestive evidence of positive associations now provides a credible source for the ongoing attempt to fill the informational vacuum reflected in public records to date.

***†Dr. David Korn, Stanford University School of Medicine, Stanford, CA:** The...epidemiological studies...are so subject to procedural and methodological challenge as to be essentially uninterpretable....I be-

lieve that the evidence of the possible carcinogenicity of EMFs is vastly insufficient to support any kind of sound decision-making with respect to new cancer regulatory policy.

***Eileen Kotter, East Brunswick, NJ:** This past October 1990, the families in my neighborhood realized that there appeared to be [four] children experiencing neurological problems....The only common factor that we can discern is that our affected children have been sleeping in rooms with milligauss levels ranging from 22 to 38 and playing in areas where the level is as high as 117.

Dr. James Lin, on behalf of the Committee on Man and Radiation, IEEE: At present, there is no scientific consensus as to which factors, the electric field and/or the magnetic field, are biologically important.

Dr. James Lin, University of Illinois, Chicago: I am disturbed by a melange of frequencies and responses taken from different spectra strung together in the name of NIER.

***†Dr. Mark Mandelkern, University of California, Irvine:** [All the mechanisms of interaction are] implausible....It's hard to understand this phenomenon.

***Dr. Martin Meltz, University of Texas Health Science Center, San Antonio:** The committee should consider asking for a complete rewrite of the document.

***Dr. Sol Michaelson, University of Rochester, NY:** Mayor Connors's [Scranton, PA] anxiety and concern have been needlessly encouraged by the EPA report....Hysteria could cause greater biological effects than EMFs.

Michigan Residents Against Giant Energy (RAGE), Michigan citizens' group: We urge this committee to release this report and its findings, not diluted or influenced by the pressures of corporate politics.

***Rep. Frank Pallone (D-NJ):** [M]y hope is that this report will serve as the catalyst to federal action that will help...to set the stage for the type of credible, comprehensive research program I believe we desperately need, and which the public increasingly will demand.

Parents Against an Unsafe Environment (PAUSE), Pennsylvania citizens' group: Grass-roots organizations are forming all across the [U.S.] to fight power lines, radio towers and substations....Of particular interest is the fact that power companies are spending a disproportionate amount of money defending their stances compared to the citizens' groups which challenge them.

Dr. Charles Polk, University of Rhode Island, Kingston: I find that the...statement in the "executive summary" [p.1-5, paragraph 1] is very responsible, clear and fully justified.

Joel Ray, coauthor of The Electric Wilderness, Ithaca, NY: That the mechanisms of interaction of NIER and biological processes are not fully understood should be no argument against classification as a "probable human carcinogen" by EPA on the basis of the weight of the evidence.

***Kirvil Skinnarland, Seattle City Light, Seattle, WA, and the Large Public Power Council (LPPC):** Reviews of the existing scientific literature have been prepared by numerous organizations, and we in the LPPC believe that the EPA review of previous studies should be the last. There is almost universal agreement that more research is needed. Now is the time to move ahead to the next stage—additional research. We need answers, and we need them sooner rather than later.

Dr. Thomas Tenforde, BPNL: [T]here are still two major problems with the document: one, the literature review is not critical....two,

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there is a consistent tendency to give more weight to positive findings of putative [EMF] effects than to studies where no effects were observed....I feel that it would be a serious mistake to release this document in its present form....

*†**Dr. Dimitrios Trichopoulos, Harvard University School of Public Health, Boston, MA:** A widespread and exponentially increasing exposure...would have created a 20th century epidemic of childhood cancer similar to that of lung cancer. There is no such evidence and, accordingly, the proposed association of ELF EMFs with childhood cancer lacks epidemiologic coherence.

***Sharon Webster, Alexandria, VA:** I [have] exercised "ultimate avoidance" by moving my children completely out of a home which had a milligauss level one moderately warm day of 50. This was done at great economic and personal expense....[A]s I looked around at the number of children in the neighborhood with neurological and/or learning disabilities, I felt that I had no choice.

Hawaii, EPA Studying Cancer Near Navy RF Base

The Hawaii Department of Health (DOH) and the Environmental Protection Agency (EPA) are investigating the possibility that radiofrequency (RF) radiation from Navy transmitters may be linked to a cluster of childhood leukemia cases. The Navy communications complex at Lualualei near Honolulu has been the subject of concern among local residents since 1982 (see *MWN*, J/A82, M/J87 and S/O90).

EPA sent a team to the site in late November to take measurements at the request of the DOH. Ed Mantiply of EPA's Office of Radiation Programs (ORP) in Las Vegas, NV, told *Microwave News* that the field levels were consistent with those the Navy measured in 1982. He did not specify the readings, however, explaining that they will not be disclosed until the agency completes its report later this year.

When the Navy took readings in 1982, the highest radiation levels at the boundary of its facility were 83 V/m for very low frequency (VLF) and 1.35 V/m and 4.16 mA/m for low frequency (LF). For high frequency (HF) radiation, the levels were at least 16 times (24 dB) less than the ANSI standard (63 V/m at 30 MHz and 632 V/m at 3 MHz); and for microwaves (MW), they were less than 10 $\mu\text{W}/\text{cm}^2$.

At that time, the facility included one VLF antenna, one LF antenna and several HF antennas. There were also a number of MW towers.

Dr. Bruce Anderson, deputy director of the DOH, said RF radiation is one of several possible causes of the cluster. Also under consideration in the department's "preliminary investigation" are the more than 1,000 barrels of used motor oil that were dumped improperly in and around the Wainae district where the cluster occurred. The oil contains benzene, a carcinogen, Anderson told *Microwave News*. He also noted that the cluster may have been a random occurrence. The DOH will continue its inquiry for six months to a year before developing any "tentative" conclusions, Anderson added.

U.K.'s NRPB To Review EPA EMF-Cancer Draft Report

The U.K.'s National Radiological Protection Board (NRPB) has set up an advisory group to examine the conclusions of EPA's draft report, *Evaluation of the Potential Carcinogenicity of Electromagnetic Fields*.

The group is chaired by Sir Richard Doll, an epidemiologist at the Imperial Cancer Research Fund (ICRF), and includes: Dr. Valerie Beral, also an epidemiologist at ICRF; Dr. Nicholas Day, a biostatistician at Cambridge University; Dr. Martin Gardner, an epidemiologist at the University of Southampton; Dr. Edward Grant, a physicist at King's College, London; and five NRPB staff members. The group's evaluation is expected to be complete in April. The NRPB, which advises the U.K. government on radiation safety standards, conducts research and directs technical training programs, is based in Chilton, outside of Didcot, Oxon.

Fourteen childhood leukemia cases were recorded for Wainae in the state tumor registry between 1980 and 1984, compared to the two to three cases that would normally be expected, Anderson noted. Nine of the cases were identified and reported in 1987 by the Cancer Research Center of Hawaii (see *MWN*, M/J87). The department learned of the additional cases during the summer of 1990 from local pediatrician Dr. Robert Wilkinson.

The new data were raised by Hawaiian officials at a U.S. Senate hearing held in Hawaii in August, increasing public concern. The hearing by the Senate Government Operations Committee had been called to address waste hazards in the state.

Anderson said that the childhood leukemia rate in the area did not exceed the expected rate during the ten years prior to and the five years following the cluster period, based on the registry records.

The EPA measurements were made using a broadband meter. Mantiply said he also took random extremely low frequency (ELF) electromagnetic field measurements in and around power distribution lines, noting that he did not know the locations of the cancer victims.

Mantiply conferred with Navy officials prior to taking measurements, and Navy staffers traveled with the EPA team and took their own measurements. There were no significant variances between the two sets of readings, Mantiply said.

FCC and FAA Clash Over Avionics-Broadcast EMI

Federal Aviation Administration (FAA) proposals to limit electromagnetic interference (EMI) from radio and television stations are being strongly opposed by the Federal Communications Commission (FCC) and the broadcasting industry. While the FAA is seeking to protect aircraft electronic com-

munications and navigation equipment from potentially hazardous interference, the FCC and broadcasters claim that the new rules are unnecessary and that compliance would be very costly for regulators and industry alike.

Under the proposed rules, the FAA would have to be notified of any construction or alteration of very high frequency (VHF) television transmitting stations or radiofrequency (RF) transmitters operating at frequencies above 30 MHz and with an effective radiated power above 10 kW. The new rules would also classify EMI as a "potential obstruction" to aircraft, restricted by the same rules as physical structures.

"All the new rules do is clarify some gray areas," Gerald Markey, manager of the FAA's Spectrum Engineering Division, told *Microwave News*, adding that, "We have been accused of being conservative, but when it comes to air safety, it's our job to be conservative. If radiation interferes with an aircraft's communication system, we consider it a hazard to aviation."

The FCC does not agree. "While the FCC certainly endorses and shares the goal of improved air safety, we believe the proposed FAA rules would impose substantial additional costs—without offsetting benefits—on the FCC as well as the communications industry," wrote FCC Chairman Alfred Sikes in a January 4, 1991 letter to Samuel Skinner, Secretary of Transportation. The FAA is part of the Department of Transportation.

"Because it failed to consider the legitimate needs and views of the FCC and communications licensees when it prepared its proposed new rules, the FAA has produced proposals that are technically flawed and discriminatory...against communications licensees. These proposed rules wholly fail to serve the public interest," argued the National Association of Broadcasters (NAB) in a joint statement with the Association for Maximum Service Television. The FAA proposals have also met with objections from the land-mobile radio and cellular telephone industries.

FM radio and VHF television transmitters, which operate at frequencies close to the aircraft communications band, would be affected most directly by the new rules.

The FAA and the FCC have been struggling for control over the broadcast spectrum for over a decade. In 1978, Congress directed the FAA to consider EMI. In the years that followed, increased FAA regulation of EMI consistently met with opposition from the FCC and broadcasters.

In 1985, the FCC proposed rules to enhance the compatibility of FM broadcasts with aviation electronics. These rules were criticized as too lenient by the FAA and were never adopted (see *MWN*, My85). Though both agencies acknowledge the need to cooperate, they have yet to agree who has the final say on EMI.

The FAA's notice of proposed rulemaking appeared in the August 3, 1990 *Federal Register* (pp.31,722-31,738).

Try *EMF Papers*, the *Microwave News* clipping service (see p.16)

OSHA Warning on RF Shocks and Burns near AM Transmitters

The Occupational Safety and Health Administration (OSHA) has issued a warning against potential radiofrequency (RF) shocks and burns to longshoremen working near AM radio transmitters.

The September 5 bulletin was prompted by reports of burns suffered by longshoremen while unloading cargo in San Francisco, CA. According to OSHA, a crane cable picked up RF energy from nearby AM radio transmitters and discharged it into the workers. An OSHA health response team measured currents in the cables as high as 200 mA—double the proposed American National Standards Institute (ANSI) exposure limit for controlled environments. (The proposed limit for uncontrolled environments is 45 mA.)

Mac Cheeks, an OSHA spokesman in Washington, DC, told *Microwave News* that the wharf is considered to be a "controlled environment," even though the AM stations are not part of the work site. At a June 1989 meeting of the subcommittee charged with revising the 1982 ANSI RF limits, the definition of a "controlled" environment was a hot topic of debate (see *MWN*, S/O89). Cheeks pointed out that the longshoremen's electric field exposures were only 10 V/m—well below the 1982 ANSI safety limit of 632 V/m at AM frequencies.

In an interview, Bob Curtis, director of OSHA's Health Response Team in Salt Lake City, UT, pointed out that RF shocks and burns occur well below the ANSI contact standards. "It's a real hazard," he said.

OSHA has recommended that dock employers protect workers unloading cargo at the San Francisco site by placing an insulator between the crane hook and the crane cable, by grounding the crane cable or by providing insulating clothing.

Similar shock and burn hazards were documented in 1988 by Paul Gailey, a consultant now based in Salt Lake City, UT, at the H-3 highway site on Oahu, HI, located under an OMEGA transmitter operating at 10–13 kHz (see *MWN*, J/A88). Gailey's report for the U.S. Coast Guard was highly controversial at the time; however, OSHA has since imposed specific requirements at the worksite to protect against RF shocks and burns, according to Curtis.

In 1982, *Chemical Engineering* magazine warned of possible fire hazards at chemical plants located near AM transmitters (see *MWN*, Ap82).

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FROM THE FIELD

Testimony Prepared for the January 17 Congressional Hearing

Rep. George Miller (D-CA), chairman of the House Interior Subcommittee on Water, Power and Offshore Energy Resources, scheduled a hearing for January 17, 1991 to investigate whether the White House's OSTP had interfered with the release of EPA's report on EMFs and cancer. The hearing was canceled at the last minute due to the war in the Persian Gulf. At press time, a subcommittee staffer told Microwave News that the hearing would be rescheduled in the near future, but could not specify a date. Microwave News has obtained the written statements of EPA, NCI and OSTP officials who had been asked to appear. The following are excerpted from their prepared statements.

[Abbreviations: CDC—Centers for Disease Control; CIRRPC—Committee on Interagency Radiation Research and Policy Coordination; DHHS—Department of Health and Human Services; DOD—Department of Defense; DOE—Department of Energy; DOL—Department of Labor; EMFs—electromagnetic fields; EPA—Environmental Protection Agency; ERD—external review draft; FCCSET—Federal Coordinating Council for Science, Engineering and Technology; NCI—National Cancer Institute; ORD—Office of Research and Development; OSTP—Office of Science and Technology Policy; RF—radiofrequency; SAB—Science Advisory Board]

EPA

Erich Brethauer, assistant administrator, ORD: [A] meeting was convened by White House staff to inform our federal colleagues of [the EMF-cancer] assessment effort. This briefing occurred March 6, 1990 and included representatives from EPA, OSTP, DOE and DOD and White House staff members, among others. The briefing discussed the report and the process for completion of the document and resulted in a recommendation that other appropriate federal agencies, such as the NCI and CDC, be included in reviewing early drafts of the document.

An extensive internal review process began in March....resulted in an extensively revised draft which was distributed to a panel of external scientific peer reviewers assembled by ORD in June 1990....Approximately 700 copies of this draft were distributed between June and August 1990....Comments from that review as well as others received were considered in the revision to produce the current document, the ERD.

At this same time, recognizing the importance of EMFs, Mr. William Reilly, the administrator of EPA, asked Dr. Allan Bromley, director of OSTP, to look at the EMF issue. Mr Reilly's request was similar to a proposal originally made by DOL....

Printed copies of the ERD were received by EPA in late November and a *Federal Register* notice announcing the SAB meeting and the availability of the draft was signed...on December 13, 1990, and published in the *Federal Register* on December 17, 1990. Copies of the ERD have been made available to the public and press upon request.

I am aware that there are reports that Dr. Bromley's participation in this process held up the release of [the current draft report.] I believe it is important to set the record straight on Dr. Bromley's involvement. Following my offer to brief Dr. Bromley on this report, a request was received to schedule a briefing....Drs. [William] Farland, Robert McGaughy (the EPA document project manager) and I then met with Dr. Bromley on November 26, 1990. At this meeting we informed Dr. Bromley of the findings of the soon-to-be-released ERD and discussed the next steps in the ongoing process of scientific review. Dr. Bromley expressed concern with certain of the studies in the evaluation and with the conclusions that the agency had reached in its evaluation. He indicated that he would inform the administrator of EPA that he felt that the CIRRPC review was critical in the development of a scientific perspective and that he felt that the CIRRPC review should precede the public review of the document. We explained the difficulties with his proposal, but I indicated that I would return to the agency and further consider his recommendation.

On December 5, 1990 I met with Dr. James Mason, assistant secretary for health, DHHS, who chairs the FCCSET committee which oversees CIRRPC, to discuss CIRRPC's review of the report. We also discussed the proposed process for review of the ERD by the

agency's SAB. Staff from OSTP and DOE also attended the meeting. Dr. Mason agreed with the proposed process, but expressed reservations concerning certain technical findings of the report. We agreed to meet the next day with technical staff to discuss these concerns. On December 6, 1990, Drs. Farland, McGaughy, John Skinner (my deputy), Peter Preuss (director of my Office of Technology Transfer and Regulatory Support) and I met with Dr. Mason and technical staff from the NCI, CDC and DOE. The primary concern raised by Dr. Mason and these agency officials was that the six-page executive summary did not convey the balanced presentation of the information found in the 381-page report; and, therefore, that it might be unnecessarily alarming to the public. Concerns were also raised about the technical interpretation of some of the studies used in preparing the latest draft. While acknowledging that they had commented on the earliest draft, none of the participants had provided comments on the intermediate "workshop review draft."

Upon further deliberations within the agency, it was decided that the technical concerns expressed by Drs. Bromley, Mason and others should be dealt with by the SAB and CIRRPC review processes and, therefore, we should proceed with the SAB meeting already scheduled for January 14-16, 1991. Further, it was decided to acknowledge the current disagreement among the federal agencies with a "Note to Reviewers" that would be inserted into the document, stating, "Currently there is a disagreement among the reviewers from various agencies about the weight of evidence and the conclusions presented in the executive summary."...

These briefings, meetings and deliberations delayed our own self-imposed deadline for the *Federal Register* notice by approximately three weeks but did *not* affect the planned schedule for the SAB review and did *not* result in any changes to the document. The only change made from the agency's original review schedule is that opportunity for public comment will be delayed. This is due to the fact that, based on the reviews by the SAB and CIRRPC, the current draft document will be revised as necessary and a *Federal Register* notice will then be published requesting public comment. The final version of the document will be developed after public comment....

NCI

Dr. Richard Adamson, acting deputy director: ...Over the past decade, there have been an increasing number of reports suggesting that low frequency EMFs might be associated with cancer in humans. Overall, the observations are inconclusive and do not demonstrate a causal connection....

Occupational studies of electrical workers have suggested associations with certain cancers, particularly leukemia and brain tumors. However, these studies are difficult to interpret because electrical workers are often exposed to chemicals, solvents and other potential carcinogens....Epidemiologic studies of residential EMFs and cancer have also been inconsistent....Further, despite the great increase in

energy consumption and exposure to low frequency EMFs that has occurred in our country over the past 40 years, there has been no corresponding increase in the incidence of childhood leukemia or other childhood cancers during this same time period.

...[I]n September 1989, the NCI initiated a four-year study of childhood leukemia and EMFs in collaboration with the Children's Cancer Study Group (CCSG). The CCSG is a multicenter network of pediatric oncologists, epidemiologists and other cancer researchers from 38 institutions and affiliated hospitals across the U.S. The EMF study is part of a larger investigation evaluating the risk of childhood leukemia associated with a number of factors, including prenatal x-rays, indoor radon, childhood and pregnancy-related diseases, pregnancy-related drug use and smoking, parental occupations, household chemical exposures and family histories of cancer....

The EMF evaluation will involve approximately 600 children who developed acute lymphocytic leukemia under the age of 15, and 600 matched controls residing in six states....The study has several methodologic advantages which should clarify the potential hazard associated with EMFs. Foremost, the study includes a very strong measurement component....Second, the study will focus on recently diagnosed cases of leukemia....

Results are still preliminary but indicate that an excellent predictor of personal magnetic field exposure can be obtained from measurements of magnetic fields in the bedroom for 24 hours, coupled with spot measurements made in the family room and kitchen....

In a letter dated March 9, 1990 from EPA, the NCI was requested to review the draft [EMF-cancer report]. NCI staff members...provided written comments that were sent to EPA on April 17, 1990. All NCI reviewers agreed that the human epidemiologic data to date did not support the sweeping conclusions made in the EPA report. In our judgment the conclusions presented were not scientifically sound and were unnecessarily alarming.

Recently, staff members at the NCI reviewed the revised EPA draft report dated October 1990. A number of concerns were raised as to the accuracy of statements found in the body of the report, but most importantly the executive summary remained scientifically unbalanced and we believe it should be substantially rewritten. The available evidence is, in our view, far too weak and contradictory to support the overall message that epidemiologic studies "involving electrical power frequency exposures show a consistent pattern of response which suggests a causal link."...There appeared to be a tendency throughout the report to dismiss negative or inconclusive findings rather than weighing these inconsistencies in the overall interpretation. These problems were then carried over to the executive summary. The childhood cancer studies, in particular, are far from "strong" when all the available data are considered.

It could be made more clear in the document that no statistically significant associations of cancer with EMF measurements have been found. The few "statistically significant associations" reported in epidemiologic surveys are with indirect indicators of EMFs, such as wire code configurations and job titles. Neither job classifications nor diagrams of nearby external power lines are known to correlate well with EMF exposures in the workplace or home, and job classifications may be indicators of exposures other than to EMFs....

[Some EPA] statements rest upon the implicit assumption that the carcinogenicity of EMFs has been demonstrated, which it has not. Missing throughout is a clear statement that we cannot conclude at this time whether EMFs pose a cancer hazard....

In summary, it is not clear today whether exposure to low intensity and low frequency EMFs pose a cancer risk. Previous studies have been inconclusive and inconsistent. There are no laboratory investigations linking EMF exposures to cellular transformation or animal carcinogenesis....[W]e found that [EPA's] conclusions were not

balanced, were open to misinterpretation and, as such, were unnecessarily alarming to the American public....

OSTP

Eugene Wong, associate director for physical sciences and engineering: The issue of low level EMFs and their possible effects on health is not new to OSTP....Over a year ago—in October 1989—CIRRPC received a request from the DOL to investigate the scientific validity of possible associations between exposure to EMFs and the development of certain forms of cancer. Last summer, Dr. James Wynaarden, OSTP's former associate director for life sciences, and Dr. Bromley specifically asked CIRRPC to review the status of research in this field and recommend appropriate additional studies to clarify outstanding questions....

Last summer the administrator of EPA, William Reilly, asked Dr. Bromley if it would be possible for FCCSET to independently review [EMFs and cancer], in addition to the review that would normally be conducted by EPA's SAB....

Dr. Bromley passed on Mr. Reilly's request to Dr. Alvin Young, director of the Office of Agricultural Biotechnology at the Department of Agriculture, who is chairman of CIRRPC....

Shortly before EPA's draft report was scheduled to be released to the SAB for review, EPA was asked to brief Dr. Bromley and OSTP on the contents of the report. On November 26, 1990, Dr. Erich Brethauer, the assistant administrator of EPA, and two of his staff members, Drs. William Farland and Robert McLaughy, who were heavily involved in the preparation of the report, briefed Dr. Bromley, myself and several other members of OSTP's staff.

Much of the briefing concerned the body of the report, which, in general, is a workmanlike summary of various studies of the health effects of exposure to EMFs. However, the members of OSTP at the briefing expressed concerns that the report's executive summary contained conclusions that did not accurately reflect the content of the report. For example, the executive summary states that "[a] large number of human studies are available in which the relationships between human cancer incidence or mortality and exposure to EMFs have been investigated." In fact, the report cites only about a dozen such studies involving electrical power sources and a few more involving RF sources. Some of the studies involved very few cases, and some are assessed by the report itself to be seriously flawed in methodology. Further, many of the studies did not involve a measurement of exposure to EMFs but proximity to potential sources of such fields. Indeed, one study found that "risk tended to increase with increasing distance" from such a source.

This puzzling finding illustrates the state of uncertainty left by the existing studies, a state that is accurately portrayed in the report but not in the executive summary....

At the briefing, the OSTP staff members made no demand that EPA take any particular course of action with its report. We expressed our views and left it to EPA to decide what to do.

However, about two weeks after the briefing—but before the report had been sent to the SAB and therefore released to the public—several press reports appeared implying that OSTP was in some way delaying release of the report. This implication is patently false....

Throughout this process, the objective of OSTP has been to ensure that scientific facts are presented accurately to the public. When there is general uncertainty and disagreement within the scientific community as to the meaning and implications of research findings—as is the case with the health effects of EMFs—premature and unwarranted conclusions are inappropriate. Reports should be factual, and their executive summaries should refrain from editorializing. To do otherwise is to risk unnecessary and unwarranted public concern. I might add that the senior members of EPA are in total agreement with us on these points....

shop's keynote speaker on EMF epidemiological studies, said that such a study is a "fairly high priority."

"It is important to design very good follow-up studies on male and female breast cancer," said Dr. Patricia Buffler, director of the Southwest Center for Occupational Health and Safety at the University of Texas Health Science Center in Houston. Buffler, who is chairing another major workshop on the future direction of EMF epidemiological studies, added, "I'll make sure this issue is addressed at the workshop." The invitation-only meeting, *Future Epidemiologic Studies of Health Effects of EMF*, sponsored by the Electric Power Research Institute (EPRI), was held in Carmel, CA, February 5-8 (see *MWN*, N/D90).

The new emphasis on female breast cancer was prompted by the publication of a Norwegian study which was the third to link male breast cancer to occupational EMF exposures (see story at right). The Norwegian researchers are already planning a study of female breast cancer among telephone workers. In November 1989, Matanoski and coworkers identified a cluster of male breast cancer among young New York telephone workers (see *MWN*, N/D89). Last June, Paul Demers and Dr. David Thomas, both at the Fred Hutchinson Cancer Research Center in Seattle, WA, reported that telephone linemen, electricians and electric power workers developed male breast cancer at six times the expected rate (see *MWN*, J/A90). In a telephone interview, Thomas noted that the new finding "confirms the results of the other two studies and cannot be dismissed."

Dr. Richard Stevens of Battelle Pacific Northwest Lab in Richland, WA, has long espoused a theory on breast cancer and EMFs and/or "light-at-night" (see *MWN*, J/F87), but to date has been unable to secure funding for a study. "Stevens' hypothesis should now be tested," Dr. Michel Coleman of the International Agency for Research on Cancer in Lyon, France, said in Cincinnati.

In an unusual show of agreement, researchers from academia, industry and government all called for further studies—among them were Dr. David Savitz of the University of North Carolina in Chapel Hill, Dr. John Peters of the University of Southern California in Los Angeles, Dr. Leeka Kheifets of EPRI, Dr. Linda Erdreich of Environmental Research, Inc. in New York City and NIOSH's Dr. Teresa Schnorr and David Brown.

Many of the epidemiologists cited the evidence of EMF-induced changes in melatonin production as a rationale for pursuing the female breast cancer link (see *MWN*, J/A90). "Enough is known about the biology of melatonin in animals and humans to make the link plausible," Coleman said. And Savitz noted that the melatonin work "leads to epidemiological predictions—probably the only testable hypothesis in this field."

A number of the researchers cautioned that EMF-female breast cancer studies will not be easy. "It may be hard to do," warned Matanoski. And Milham noted, "I don't think a high proportion of female breast cancer could be related to EMFs, but if the same mechanism is operating in women as in men, you should be able to detect it in women."

Dr. Russel Reiter of the University of Texas Health Science Center in San Antonio pointed out that there are a number of different types of female breast cancer and a variety of risk

Male Norwegian EMF Workers Have Excess Breast Cancer

Norwegian men exposed to ELF EMFs on the job developed breast cancer at twice the expected rate—a statistically significant increase. The new report, published in *The Lancet*, is the third in the past year to detail an increased risk of male breast cancer—an extremely rare disease—among EMF-exposed workers (see p.1).

"The results indicate an association," wrote Drs. Tore Tynes and Aage Andersen of the Cancer Registry of Norway in Oslo, but they warned that, "the numbers are small and the results should be interpreted with caution."

Tynes told *Microwave News* that he and Andersen plan to study female telephone workers exposed to EMFs from switching equipment.

In interviews, Johns Hopkins University's Dr. Genevieve Matanoski said, "Now we have three studies. I think it's fascinating," and Battelle's Dr. Richard Stevens called the new study "extremely provocative."

Using data from their registry—considered to be one of the most comprehensive in the world—Tynes and Andersen found that electrical transport workers, including railway engine drivers and tram drivers, had a statistically significant fourfold increase of male breast cancer. The incidence among electricians was more than twice that expected, though not statistically significant. There was a significant doubling of male breast cancer risk for all the groups combined.

The researchers noted that although the subgroups they used supported the EMF-breast cancer link, "the job titles selected may not be the best for an evaluation of cancer risk to workers exposed to ELF fields.... Our results seem to support the justification of further studies on the association between breast cancer and occupational exposure to ELF fields."

Tynes and Andersen looked at cancer data on all Norwegian residents between the years 1960 and 1985, focusing on the distribution of breast cancer cases among electrical workers according to occupational status at the 1960 and 1970 censuses. For that 25-year period, they observed 12 cases of male breast cancer among 37,953 workers (824,321 person years) where 5.8 were expected. Their letter appeared in the December 22/29, 1990 issue of *The Lancet*.

factors to be considered in designing a study: "If you think melatonin is related, it would be better to look at younger women—15 to 35 years old."

Matanoski also suggested that if there is an EMF-neuroendocrine effect, the incidence of prostatic cancer among EMF-exposed men should also be investigated.

Breast cancer is the most common type of cancer among American women, according to the American Cancer Society, and the rate is on the rise (see p.2).

UPDATES

BIOLOGICAL EFFECTS

New Hypothesis for Henhouse Results...EPA's Dr. Carl Blackman has come up with a new idea to explain the variation in results obtained by the six labs that participated in the Henhouse Project. The project sought to replicate the findings of Dr. Jocelyne Leal of the Ramón y Cajal Hospital in Madrid, Spain, showing that weak PMFs can damage developing chick embryos (see *MWN*, M/A88 and S/O90). Of the six labs, five found that a 1 μ T PMF caused an increase in abnormal embryos—though only two had statistical significance. The pooled results were significant at the $p=0.001$ level. As previously reported, one of the six labs used a different strain of eggs, indicating a genetic component to the effect (see *MWN*, J/F90). In a letter published in the November/December 1990 issue of the *Bioelectromagnetics Society Newsletter*, Blackman points to a trend of declining statistical significance of the PMF effect in the five remaining labs with decreasing levels of the earth's DC magnetic field. "From this data, it is possible to hypothesize that the mean total DC flux density must be higher than 35 μ T for a field-induced effect to be observed" for experiments using the Henhouse protocol. As early as 1986, Leal herself stressed the importance of the DC magnetic field in understanding PMF effects (see *MWN*, J/F87). Blackman urges his fellow researchers to "include a test of the potential influence of the static magnetic field on the pulsed field induced effects" in future studies.

INTERNATIONAL

Dutch RF/MW Standard...The Netherlands Environmental Health Inspectorate recently published a guideline for exposure to RF radiation from stationary emitters. The guideline is based on the International Radiation Protection Association's (IRPA) RF/MW guidelines, which were revised in 1988 (see *MWN*, Mr84 and J/F88). Dr. Branko Bosnjakovic of the Dutch Ministry of Housing, Planning and Environment told *Microwave News* that the new guideline will be used by regional authorities charged with licensing TV and radio transmitters and radar facilities. Bosnjakovic is a member of IRPA's International Non-Ionizing Radiation Committee. For a copy of *Richtlijn voor Radiofrequente Straling bij Zendingrichtingen* (#90-01), available only in Dutch, contact: Ministry of Housing, Planning and Environment, Centrale Directie Voorlichting en Externe Betrekkingen, Van Alkemadeaan 85, 2597 AC's-Gravenhage, The Netherlands, (31+70) 317 41 74.

MEDICAL APPLICATIONS

NASA Resets Biological Clocks...Bright lights aren't just for treatment of seasonal affective disorder (SAD). Some NASA astronauts who work on night-shift operations are using high-intensity light to alter their circadian rhythms before space launches. According to the January 14 issue of *Aviation Week and Space Technology*, astronauts on a recent space shuttle mission were able to reset their biological clocks by using bright lights for only four days before launch. In the past, astronauts

adjusted their rhythms by going to sleep earlier and earlier over a six-week period.

MEETINGS

MRI Bioeffects...The New York Academy of Sciences (NYAS) will hold a meeting on the *Biological Effects and Safety Aspects of Nuclear Magnetic Resonance Imaging and Spectroscopy*, May 15-17, 1991, at the Hyatt Regency in Bethesda, MD. Among the presenters will be Dr. Frank Shellock of the Cedars-Sinai Medical Center in Los Angeles, CA, and Sweden's Dr. Bertil Persson of the University of Lund. Contact: NYAS at (212) 838-0230.

Medical Microwaves in Yugoslavia...Belgrade will be the site of *Microwaves in Medicine '91*, April 8-11. The meeting will address medical applications, radiation risks and safety standards. Dr. Stanislaw Szmigielski of the Center for Radiobiology and Radiation Safety in Warsaw, Poland, has been invited to present a lecture on EMFs and cancer. Contact: Prof. Z. Djordjevic, Institute of MW Techniques and Electronics, Bulevar Lenjina 165b, PO Box 220, 11070 Belgrade, Yugoslavia, (38+11) 135-420.

STANDARDS

European RFI Standard...The European Committee for Electrotechnical Standardization has asked for comments on a draft standard, *Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical (ISM) Radiofrequency Equipment* (EN 55 011 prAB). Copies are available for \$8.00 each from: International Sales Dept., ANSI, 1430 Broadway, New York, NY 10018.

Power Line Effects...The IEEE has issued a call for comments on its proposed new standard, *Definitions of Terms Relating to Corona and Field Effects of Overhead Power Lines* (BSR/IEEE 539), a revision of a 1979 standard (ANSI/IEEE 539). All comments are due by February 26, 1991. For a copy of the standard, send \$30.60 to: Michelle Phillips, IEEE, 445 Hoes Lane, PO Box 1331, Piscataway, NJ 08855. Comments should be sent to Linda Dame at the same address.

TECHNOLOGY

Maglev and EMFs...Understanding the effects of magnetic levitation systems is rapidly becoming a priority in Washington, DC. EPA has been required by the Clean Air Act Amendments of 1990, passed last fall, to report to Congress by May 15, 1991 on the "health and environmental aspects of maglev technology." The agency is also looking into EMFs from maglev trains for the Federal Railroad Administration (see *MWN*, S/O90). And the National Research Council's (NRC) Transportation Research Board is considering EMF effects as part of an ongoing project on *High-Speed Surface Transportation in the United States*. The NRC's Walter Diewald, the project officer, told *Microwave News* that although EMFs will only be a small part of the study, the committee assembled by the board will probably use the EPA EMF-cancer report to provide "some guidance." The committee is studying potential commercial applications of high-speed transportation technology, including magnetic levitation.

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