Stephen Perry, et al., "Environmental Power-Frequency Magnetic Fields and Suicide," *Health Physics, 41*, pp.267-277, August 1981.

Stephen Perry and Laurence Pearl, "Power Frequency Magnetic Field and Illness in Multi-Storey Blocks," *Public Health, 102*, pp.11-18, 1988.

Maria Reichmanis, et al., "Relation Between Suicide and the Electromagnetic Field of Overhead Power Lines," *Physiological Chemistry & Physics, 11*, pp.395-403, 1979.

Richard Stevens, "Electric Power Use and Breast Cancer: A Hypothesis," *American Journal of Epidemiology, 125*, pp.556-561, April 1987.

Bary Wilson, et al., "Chronic Exposure to 60-Hz Electric Fields: Effects on Pineal Function in the Rat," *Bioelectromagnetics, 2*, pp.371-380, 1981.

Bary Wilson, "Chronic Exposure to ELF Fields May Induce Depression," *Bioelectromagnetics, 9*, pp.195-205, 1988.

Jonathan R. Wolpaw, et al. (including Richard Seegal), "Chronic Effects of 60 Hz Electric and Magnetic Fields on Primate Central Nervous System Function," *Final Report to the New York Power Lines Project*, May 12, 1987.

CONFERENCES

New Listings

July 25-27: **Melatonin and the Pineal Gland,** Hong Kong. Contact: Alex Tzang, Executive Director, Symposium on "Melatonin and the Pineal Gland," c/o BDG Management Ltd., East Town Bldg., Suite 705, 41 Lockhart Rd., Hong Kong, (5) 286136.

July 29-31: **1988 International Tesla Symposium,** Colorado Springs, CO. Contact: International Tesla Society, 330A W. Uintah, Suite 215, Colorado Springs, CO 80905, (719) 570-0876.

September 13-16: **6th National Association of Regulatory Utility Commissioners (NARUC) Biennial Regulatory Information Conference,** Hyatt Regency, Columbus, OH. Contact: David Wirick, National Regulatory Research Institute, 1080 Carmack Rd., Columbus, OH 43210, (614) 292-9404.

September 21-23: **1988 Symposium on Antenna Applications,** Allerton Park, Monticello, IL. Contact: Paul Mayes, Department of Electrical and Computer Engineering, University of Illinois, 1406 W. Green St., Urbana, IL 61801, (217) 244-0543.

October 3-6: **5th Annual Electronic Imaging '88,** World Trade Center, Boston, MA. Contact: Ed Martin, MG Expositions Group, 1050 Commonwealth Ave., Boston, MA 02115, (617) 232-EXPO.

October 30-November 3: **DOE-EPRI Review of Research on Biological Effects of 50/60 Hz Electric and Magnetic Fields, Air Ions and Ion Currents,** Hyatt Regency, Phoenix, AZ. Contact: W/L Associates, 120 W. Church St., Frederick, MD 21701, (301) 663-1915.

1989

May 23-25: **IEEE 1989 National Symposium on Electromagnetic Compatibility,** Radisson Hotel, Denver, CO. Contact: Dave Hill, PO Box 4056, Englewood, CO 80155, (303) 497-3472.

August 28-September 1: **6th International Symposium on High Voltage Engineering,** Westin Canal Palace Hotel, New Orleans, LA. Contact: Professor P.B. Jacob, Electrical Engineering Dept., Mississippi State University, PO Drawer EE, Mississippi State, MS 39762, (601) 325-3912.

September 26-29: **International Conference on High Frequency/Microwave Processing and Heating,** Arnhem, The Netherlands. Contact: KEMA, PO Box 9035, 6800 Et Arnhem, The Netherlands.

Upcoming Meetings

July 4-8: **33rd Annual Meeting of the Health Physics Society (HPS),** Sheraton Boston Hotel & Towers, Boston, MA. Contact: HPS, 8000 Westpark Dr., Suite 400, McLean, VA 22102, (703) 790-1745.

July 5-7: **Military Microwaves '88: Conference and Exhibition,** Wembley Conference Center, London, U.K. Contact: Patrick Pinches, Microwave Exhibition and Publishers, 90 Calverley Rd., Tunbridge Wells, Kent TN1 2UN, U.K., (0892) 44027.

July 12-15: **4th Joint Magnetism and Magnetic Materials – Intermag Conference,** Hotel Vancouver, Vancouver, BC, Canada. Contact: Diane Suiters, Courtesy Associates, 655 15th St., NW, Suite 300, Washington, DC 20005, (202) 639-5088.

July 24-29: **1988 Power Engineering Society Summer Meeting,** Hilton and Marriott Hotels, Portland, OR. Contact: IEEE Society Special Services, 345 East 47th St., New York, NY 10017, (212) 705-7895.

August 2-4: **IEEE 1988 International Symposium on Electromagnetic Compatibility,** Westin Hotel, Seattle, WA. Contact: Don Weber, Hamilton Engineering Inc., 2108 SW 152nd St., Seattle, WA 98166, (206) 244-0952.

August 8-12: **Non-Ionizing Radiations: Biophysical and Biological Basis, Applications and Hazards in Medicine and Industry,** MIT, Cambridge, MA. Contact: Director of Summer Sessions, Room E19-356, MIT, Cambridge, MA 02139, (617) 253-2101.

August 15-19: **Gordon Research Conference on Bioelectrochemistry,** Plymouth State College, Plymouth, NH. Contact: Dr. Betty Sisken, Department of Anatomy, University of Kentucky, Lexington, KY 40506, (606) 257-5796.

August 20-26: **7th Annual Scientific Meeting and Exhibition of the Society of Magnetic Resonance in Medicine (SMRM),** San Francisco Hilton & Towers, San Francisco, CA. Contact: SMRM, 15 Shattuck Sq., Suite 204, Berkeley, CA 94704, (415) 841-1899.

August 29-31: **23rd Microwave Power Symposium,** Skyline Hotel, Ottawa, Ontario, Canada. Contact: International Microwave Power Institute, 13542 Union Village Circle, Clifton, VA 22024, (703) 830-5588.

September 12-15: **18th European Microwave Conference,** Folkets Hus, Stockholm, Sweden. Contact: Microwave Exhibitions and Publishers, 90 Calverley Rd., Tunbridge Wells, Kent TN1 2UN, U.K., (0892) 44027.

September 27-29: **10th Annual Electrical Overstress/Electrostatic Discharge Symposium,** Marriott Hotel, Anaheim, CA. Contact: Michael Martin, 3M/Static Control Systems Division, 2111 W. Braker Lane, Bldg. 501, PO Box 2963, Austin, TX 78769, (512) 834-3117.

October 9-12: **8th Annual Meeting of the Bioelectrical Repair and Growth Society (BRAGS),** Mayflower Hotel, Washington, DC. Contact: BRAGS, PO Box 64, Dresher, PA 19025, (215) 659-5180.

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October 24-28, 1988

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New Listings

RCA Pays $250,000 To Settle Yannon Microwave Injury Suit

The widow of a New York Telephone Co. radio technician has settled a 1976 product liability suit against the RCA Corp. for a record $250,000. In the suit, Mrs. Antoinette Yannon charged that RCA was responsible for the wrongful death—due to long-term microwave exposure—of her husband, Samuel Yannon.

"It took me 13 long years. I could write a book about what they put me through," Mrs. Yannon, a resident of Staten Island, NY, told *Microwave News*. "I would have loved to have the story come out in court, but the lawyers advised against it because they said I would not live to collect."

Mrs. Yannon's case, filed in May 1976, was initially thrown out on procedural grounds, but, following two successful appeals, the case was scheduled to go to trial on the merits when a settlement was reached.

In the past, similar cases have been settled with the stipulation that details of the agreement be kept confidential. In this instance, however, no such conditions were enforced, according to Sheridan Albert, one of Mrs. Yannon's attorneys, who is with the New York City firm of Schneider, Kleinick & Weitz. "Nobody puts a gag on me," he said in a telephone interview. Mrs. Yannon was also represented by Jerome Ellis and David Paully of Staten Island.

RCA's insurance company paid Mrs. Yannon and her children $154,688; the remaining $95,361 will cover her legal fees. In addition, expert witness fees and related costs totaling $18,041 will come from Mrs. Yannon's share of the award. RCA's attorneys refused to divulge the name of the insurance company, but, according to the "closing statement" filed with the court, RCA was covered by the Zurich Insurance Group.

(continued on p.13)

Canadian Utility Offers To Buy Homes Next to Power Line ROW

A Canadian utility has made an unprecedented offer to buy the homes along a power line right-of-way (ROW) on Vancouver Island. British Columbia (BC) Hydro is prepared, upon request, to pay a fair market price to landowners concerned about increased electromagnetic fields (EMFs) from a new 230 kV line. BC Hydro will then put the purchased properties back on the market.

The 90-mile 230 kV Dunsmuir-Gold River power line was built on an existing ROW which already had two 138 kV lines, according to a utility spokesman, who said that all but 20 miles of the line is in an unpopulated area. The new line, which will serve a pulp and paper mill, is scheduled to

(continued on p.14)

HIGHLIGHTS

Double-Blind Studies Show Efficacy of PEMF Treatment

After years of controversy as to whether the application of pulsed electromagnetic fields (PEMFs) is an effective therapy, new double-blind studies are showing that PEMFs can indeed help mend fresh and nonunion fractures, tighten prostheses, heal skin lesions, ease pain and treat osteoporosis. Eight double-blind studies, each with statistically significant results, were presented at *Electrobiology Today: An International Symposium in Honor of Luigi Galvani*, held in Bologna, Italy, in mid-April.

Professor W.J.W. Sharrard of the University of Sheffield, U.K., reported an improvement of tibial fractures with delayed unions when treated with PEMFs for 12 weeks. Sharrard found clinical and radiological evidence of union in 25% of the 20 patients who received PEMF treatment, compared to only 4% among the 25 controls ($p<0.01$). The patients, who were enrolled between 1981 and 1985, were treated more than 16 weeks—but less than 32 weeks—after injury.

On his return from the Bologna meeting, Dr. Andrew Bassett, professor emeritus of orthopaedic surgery at Columbia University's medical school in New York City, told *Microwave News* that the new results "should wipe out the last vestige of skepticism in the few members of the academic community who have made a profession of denigrating the biological activity of PEMFs." Bassett is well-known for his pioneering studies on the medical uses of PEMFs.

"Double-blind studies are extraordinarily hard to do. Dr. Sharrard must be complimented for completing this study," Dr. Brian Pethica of Electro-Biology, Inc. (EBI), the leading manufacturer of PEMF devices, said in a telephone interview. Pethica, who is the vice president for research at EBI in Parsippany, NJ, was also at the Bologna meeting. "The field has advanced very rapidly over the last few years," he said.

Sharrard's report was particularly welcome news to the PEMF community because, in 1984, he and his coworkers reported interim results that cast doubt on the efficacy of PEMF therapy (see *MWN*, Ju84). Sharrard told *Microwave News* that the way cases were selected in the 1984 trial tended to skew the results "rather considerably." He also pointed out that their fractures did not unite for a year or more. Overall, he called the 1984 paper "inconclusive, rather than negative." Sharrard said that a paper describing his new results is undergoing final editing prior to publication.

Of the seven other double-blind studies reported at the Bologna meeting, one was by an American-Australian group on the use of PEMFs for the treatment of loose cemented hip prostheses.

The other six double-blind studies were by Italian researchers. A group led by Dr. G. Borsalino of the Department of Orthopaedics and Traumatology at Montecchio Hospital reported on 32 patients treated with femoral intertrochanteric osteotomies (a surgical procedure for arthritis of the hip). Those treated with a 75 Hz signal showed a statistically significant improved rate of healing. A paper describing the team's findings appeared in *Clinical Orthopaedics and Related Research*, No.237, pp.256-263, December 1988. Send reprint requests to: Dr. Ruggero Cadossi, University of Modena, Clinica Medica II, Policlinico, Via del Pozzo 71, 41100 Modena, Italy.

The other Italian papers were reports on the use of PEMFs for the treatment of non-cemented knee prostheses, fresh femoral fractures, skin lesions, osteoporosis and pain.

For more information on these studies, contact: Dr. Angelo Gusella or Stefano Nardi, Divisione Ortopedica, Istituti Ortopedici Rizzoli, Via G.C. Pupilli 1, 40136 Bologna, Italy, (051) 63.66.225.

The abstracts of the papers presented at the Bologna symposium will be published in the *Journal of Bioelectricity*, edited by Dr. Andrew Marino of the Louisiana State University Medical Center in Shreveport, LA, at the end of the year.

Did EMI Cause a Bomb To Fall from an F-16?

Electromagnetic interference (EMI) may have triggered an electro-explosive device (EED) aboard a U.S. Air Force (USAF) F-16 jet, releasing a 500-pound bomb in western Georgia, the *Macon Telegraph and News* reported on May 11.

During a routine training mission on May 4, an F-16 pilot was unable to release a bomb over the target area. As the pilot circled back over Marion County, the bomb dropped, shaking windows up to 1,000 feet away. There were no casualties, however.

The USAF and the U.S. Army are now investigating a number of potential causes—including radio signals from transmitters and radars at nearby Fort Benning—of the unintentional release. A report should be available by August, a USAF spokeswoman told Stuart Leavenworth of the Macon newspaper. Members of Georgia's Congressional delegation are monitoring the investigation.

EMI-related problems have become a recurring news story in Georgia. For more than a year, the PAVE PAWS radar at Robins Air Force Base (AFB) has been at the center of a controversy over whether EEDs aboard aircraft flying through the radar's main beam are in danger of detonating (see *MWN*, J/A88, N/D88 and J/F89).

A spokesman at Moody AFB, GA, where the F-16 is stationed, told *Microwave News* that the jet was equipped with EEDs which are used to facilitate the release of bombs.

The Department of Defense has become sensitive to the threat posed by EMI and recently initiated a three-year, $30 million study of the compatibility of the electronic weapons used by the different branches of the military (see *MWN*, M/A89).

European Bioelectromagnetics Society To Be Formed

Planning is underway to form a European Bioelectromagnetics Society (EBEMS). Dr. Jocelyne Leal, who is leading the effort to create the new group, believes it is needed to reinforce contacts among European scientists and to facilitate setting up collaborative research projects financed with European funds. EBEMS will address both biomedical applications and health effects of electromagnetic fields.

EBEMS has the blessing of many members of the Bioelectromagnetics Society (BEMS), which is based in the U.S. Dr. Tom Rozzell of the National Research Council in Washington, DC, who was one of the founders of BEMS in 1978, has argued that there are "compelling reasons" for the creation of EBEMS.

How the two societies will coordinate their activities is still unclear. Leal, who is based in Madrid, Spain, told *Microwave News* that she would like to establish a "strong and effective relationship" between EBEMS and BEMS. Specific details about this relationship—for instance, whether they will have joint meetings and share the same journal—are currently under discussion.

In addition to Leal, the members of the EBEMS planning committee are: Drs. Alessandro Chiabrera (Italy), Sylvia Fitton-Jackson (U.K.), Maurice Hinsenkamp (Belgium) and Bernard Veyret (France). BEMS has also set up a committee to act as a liaison between the two societies.

For more information, contact: Dr. Jocelyne Leal, Department of Research, Hospital Ramón y Cajal, Carretera de Colmenar, Km 9, Madrid 28034, Spain, (1) 336-8699.

Nuclear Plant Alert Set Off by RFI from Hand-Held Radios

On the night of April 22, the Nine Mile Point-2 nuclear power plant went on alert when radiofrequency interference (RFI) from workers' hand-held radios created noise in the low-voltage circuitry, causing the plant's turbine control valves to close, *Nucleonics Week*, an industry newsletter, reported in its April 27 issue. The safety system switched on and there was no damage to the 1,165 megawatt (MW) plant, which is operated and partly owned by the Niagara Mohawk Power Corp. The Nine Mile plant is located near Oswego, NY, on Lake Ontario.

"We're going to reidentify those areas of the plant that are especially sensitive to interference and post warning signs," Stephen Brady, a Niagara Mohawk spokesman, told *Microwave News* from his office in Syracuse, NY. He added that the company will redouble its emphasis on training personnel to take the necessary precautions so that similar situations do not occur again.

In a telephone interview, Jon Johnson of the Nuclear Regulatory Commission's (NRC) regional office in King of Prussia, PA, said that this type of RFI does occur, but that, "it has not been a serious safety problem." He said that, "Most plants, if not all, have done surveys on where radios can cause RFI and have published procedures for their use." There are no overall NRC rules governing the use of walkie-talkies in nuclear plants, according to Johnson.

In February 1982, the No.2 reactor at the Three Mile Island nuclear power plant in Middletown, PA, went on alert for eight-and-a-half hours before officials discovered that radio signals from a portable two-way radio were interfering with a combustible gas meter, leading operators to believe that hydrogen gas was accumulating inside the reactor (see *MWN*, Mr82). The plant was the site of a major accident in 1979.

Brodeur on Power Lines, Radar and VDTs in "The New Yorker"

Paul Brodeur, the author of *The Zapping of America*, is publishing a three-part series on the health, scientific and political issues related to power line, radar and video display terminal (VDT) electromagnetic fields in the June 12th, 19th and 26th issues of *The New Yorker*, a national magazine.

A book will follow in the fall: *Currents of Death: Power Lines, Computer Terminals and the Attempt To Cover Up Their Threat to Your Health* will be published by Simon and Schuster.

Brodeur has also written books on asbestos and articles on ozone-depleting chemicals—all of which first appeared in *The New Yorker*. *The Zapping of America* was serialized in the magazine in December 1976.

FCC on Part 15 RF Rules and Measurement Procedures

The Federal Communications Commission (FCC) has made major changes in the way it regulates non-licensed devices that emit electromagnetic energy and has proposed new methods of measuring their radiated and conducted emissions.

On April 18, the commission released the final version of its Part 15 rules, which govern the use of such non-licensed radiofrequency (RF) appliances as remote control units, garage door openers and cordless telephones. The revised rules, first proposed in October 1987, are designed to establish uniform technical standards to replace the previous case-by-case approach (see *MWN*, N/D87).

The FCC argues that the new rules remove "unnecessary regulatory barriers" for new services, such as wireless computers and other high speed data transmission and consumer

video systems. At the same time, they tighten up certain emissions limits, thus avoiding the risk of interference to licensed radio and TV broadcasting.

According to the FCC's John Reed, some of the key changes in the final rules are that: (1) a ban has been imposed against any new devices operating in the TV broadcast band —the FCC notes the importance of not hampering the development of high-definition TV; (2) a number of restricted frequency bands have been added—including those used for LORAN-C, wind shear detection and radio astronomy; and (3) for frequencies above 1 GHz, limits are based on average values, in contrast to the limits on emissions below 1 GHz, which are specified in terms of CISPR quasi-peaks, although a cap here is also specified (20 dB).

The revised rules are under attack from a variety of sources, Reed told *Microwave News*. Linear Corp. and Sensormatic Electronics Corp. have already petitioned the FCC for reconsideration, and Reed expects others will follow.

Indeed, the American Radio Relay League (ARRL) has announced that it too will ask the FCC to reconsider. In the June 1989 issue of *QST*, the ARRL's monthly magazine, the league calls some of the rules "ghastly." For instance, the ARRL believes that the FCC's new "consumer bands" allow a host of different types of equipment to emit too much radiation.

On the other hand, the National Association of Broadcasters (NAB) takes a more positive view. "Overall, we're reasonably satisfied with the rules' protections," NAB staff engineer Kelly Williams said in a telephone interview.

Measurement Methods

On May 17, the FCC's Office of Engineering and Technology (OET) announced three new proposals on how to measure radiated and conducted emissions from devices regulated under Part 15. The proposals cover the following types of devices (the document designations are given in italics):

- Intentional radiators, including wireless microphones, cordless telephones and household intercom systems (*OET TP-3*);
- Unintentional radiators, including radio and TV receivers and cable terminal devices—but excluding digital devices, CB receivers and carrier current systems (*OET TP-4*);
- Intentional radiators which operate periodically, including emergency alarms and door openers (*OET TP-6*).

At press time, the actual proposals had not yet been released.

These proposals follow the recent release of a new procedure (*OET TP-5*) for measuring emissions from digital devices (see *MWN*, M/A89). AT&T and the Computer and Business Equipment Manufacturers Association (CBEMA) have requested an extension of the deadline for filing comments and reply comments. They are now due June 7 and July 7, respectively.

For more information on the final Part 15 rules, contact: John Reed, FCC, 1919 M St., NW, Washington, DC 20554, (202) 653-7313. And for more information on the new measurement procedures, contact the FCC's Paul Marrangoni at (202) 653-8107; to order copies of the procedures, contact: Virginia Cannon, Downtown Copy Center, 1114 21st St., NW, Washington, DC 20036, (800) 541-1194 or (202) 452-1422.

U.K.'s NRPB Issues Guidance

In mid-May, the National Radiological Protection Board (NRPB), based in Didcot, U.K., issued recommendations on public and occupational exposures to all frequencies up to 300 GHz, including power line electromagnetic fields.

Microwave News will feature a complete report in the July/August issue.

ELF NEWS

« Power Line Talk »

Make room on your bookshelves for **four new books** on EMF bioeffects which will be available by the fall. In addition to **Paul Brodeur**'s forthcoming book on power lines and VDTs (see p.3), Dr. **Robert Becker** will come out with the tentatively-titled *Healing the Body Electric*, to be published by Jeremy Tarcher, Inc., of Los Angeles, CA. Becker, the author of *The Body Electric*, covers both the promise and the peril of the human use of EMFs. Becker looks at the role of EMFs in ancient and modern techniques of healing, as well as at the implications of upsetting the natural environmental balance. Battelle's Drs. **Larry Anderson, Richard Stevens** and **Bary Wilson** have edited a collection of papers for a volume called *Extremely Low Frequency Electromagnetic Fields: The Question of Cancer*—they also wrote many of the chapters. The collection, which will be published by Battelle, will feature reviews on such topics as the pineal gland, oncogenes, calcium homeostasis and ion cyclotron resonance. In their preface, the editors note that their book is intended to be "provocative and useful." On the other side of the Atlantic in the U.K., Dr. **Cyril Smith** of the University of Salford, and **Simon Best**, a medical journalist, have written *Electromagnetic Man: Health and Hazard in the Electrical Environment*, which will be published by Dent & Sons of London at the end of July. Smith and Best link EMFs to allergies, depression, pain and some forms of cancer, and provide coherent explanations of homeopathy and parapsychology. They also "show

what action can be taken against the dangerous effects of EMFs, as well as how we can make beneficial use of them."

«« »»

The annual tug of war over **DOE**'s ELF research budget is starting again. As in past years, the Administration has proposed $2.2 million for EMF effects research for FY1990. Last year, due to public pressure, the research program ended up with an additional $800,000 (see *MWN*, S/O88). Now the question is whether the DOE program will succeed in getting $3 million again. Dr. **Imre Gyuk**, program manager of the DOE's Office of Energy, Storage and Distribution, told *Microwave News* that the proposed $2.2 million budget would result in "considerable cutbacks" in the program's ongoing projects. Some members of Congress are seeking $4 million—a level that is supported by the **American Public Power Association** (APPA). In an April statement to Congressional appropriations subcommittees, the APPA urged them to increase their support "to keep this important program on track." Research is needed, according to the APPA, because, "Almost every proposed new transmission line is currently being questioned—and some have been entirely blocked—by those concerned about possible health effects and potential decreases in property values because of perceived health effects." The final budget resolution is not expected until October.

«« »»

Dr. **Nancy Wertheimer** and **Ed Leeper**'s analysis of the **Battelle** epidemiological study of **adult leukemia** will be published in a letter appearing in the August 1989 issue of the *American Journal of Epidemiology;* they show a link between residential EMF exposures and adult leukemia when magnetic field exposures from electric blankets and water beds are taken into account. Last year, Wertheimer and Leeper reported that the risk of leukemia was 50-90% higher than expected among people exposed to magnetic fields from electrically heated beds or power lines and that the risk increased to 110-260% above controls for those exposed to both (see *MWN*, M/J88). Battelle's Dr. **Richard Stevens** and his collaborators will publish their response in the same issue of the journal. They note that an association between adult leukemia and residential ELF field exposure cannot be ruled out because of their study's small sample size and the potential misclassification of exposures.

«« »»

"Why expose ourselves, and our customers, to any risk?" asks a Canadian company which is marketing what it calls a **"field-free" water bed heater**. In its ads, the Toronto-based Halcyon cites the 1986 Wertheimer-Leeper study on electric bed heaters and miscarriage risks, and claims that its product provides "an unquestionably safe alternative"—the company believes that there is "minimal, if any, danger" from exposure to EMFs. Despite repeated requests from *Microwave News*, the company has not provided any additional information.

IRPA Revises ELF Guidelines: Cancer Risk "Not Convincing"

The International Radiation Protection Association (IRPA) has approved new interim guidelines for human exposures to 50/60 Hz electromagnetic fields (EMFs). The guidelines, which were developed by IRPA's International Non-Ionizing Radiation Committee (INIRC), specify public exposure limits for electric and magnetic fields of 5 kV/m and 0.1 mT (1,000 mG), respectively.

The extremely low frequency (ELF) limits seek to protect workers and the public from "established or predicted immediate health effects"; they are not based on cancer risk. "Current evidence from the epidemiological studies suggesting an association between the cancer incidence and residential or workplace exposure to 50/60 Hz EMFs is not convincing," according to the IRPA/INIRC, but "these results raise a hypothesis that needs to be tested."

Dr. Richard Phillips of the Environmental Protection Agency's Health Research Laboratory in Research Triangle Park, NC, criticized the new IRPA limits as too lenient. "It's ridiculous—they are not representative of our state of knowledge." Phillips, who served on the 1984 World Health Organization's (WHO) and IRPA's Task Group on ELF Fields, said that, "The document reflects the views of the members of the committee and the committee does not really represent the overall scientific community. It represents one extreme of the distribution of the various scientific opinions."

The new interim guidelines are based on biological effects due to internal currents induced by external electric and magnetic fields—they are designed to limit induced currents to approximately 10 mA/m^2.

In 1987, the IRPA/INIRC circulated a review draft of the 50/60 Hz guidelines specifying magnetic field exposure limits which, though based on the same 10 mA/m^2 limit, were more lenient—by a factor of ten for workers and by a factor of two for the general public (see Table on p.6 and *MWN*, M/A88). The electric field limits are essentially unchanged from those proposed two years ago.

In an interview with *Microwave News*, Dr. Michael Repacholi, the chairman of the IRPA committee, said that, in developing the new guidelines, the committee sought to set levels for the general public that are five times stricter than those for workers—as IRPA has recommended for exposures to radiofrequency and microwave radiation (see *MWN*, Mr84 and J/F88). He added that, while this could be done for magnetic fields, it would not be possible for electric fields if contact currents and transient discharges were to be taken into account.

Magnetic Field Guidelines

The IRPA residential magnetic field limits are approximately 1,000 times more lax than the levels linked to cancer by the Wertheimer-Leeper, Tomenius and Savitz epidemiological studies. For instance, in an effort to protect against such a risk, an Oregon state legislator proposed a standard of 2 mG earlier this year (see *MWN*, M/A89).

The IRPA guidelines are also much looser than those adopted by the state of Florida earlier this year for power line rights-of-way (see *MWN*, M/A89). The Florida limits are not health-based standards, but are set at a "technologically achievable" level, according to a state official.

The May 1987 draft of the guidelines, which predated the publication of the Savitz study, pointed out that the residential epidemiological studies—specifically those by Wertheimer-Leeper—could not be considered in a health risk evaluation because of their many inherent deficiencies.

"The Savitz study tends to support the earlier studies, but we nevertheless concluded that chronic low-level EMF exposure has not been established to increase the risk of contracting cancer," Repacholi told *Microwave News*. "Similarly, no definitive conclusion can be drawn from the occupational studies," he said. Repacholi is the chief scientist at the Royal Adelaide Hospital in Adelaide, South Australia.

IRPA/INIR Committee

The members of the IRPA/INIRC are as follows (see *MWN*, J/A88):

Drs. Jürgen Bernhardt (F.R.G.); Branko Bosnjakovic (The Netherlands); Przemyslaw Czerski (U.S.); Annette Duchêne, Scientific Secretary (France); Martino Grandolfo (Italy); Dietrich Harder* (F.R.G.); Henri Jammet (France); Bengt Knave (Sweden); John Marshall* (U.K.); Michael Repacholi, Chairman (Australia); David Sliney (U.S.); and Jan Stolwijk (U.S.).

*Retired

IRPA/INIRC Interim ELF Human Exposure Guidelines

	Electric Field kV/m (rms)		Magnetic Field mT* (rms)	
	May 1989	May 1987†	May 1989	May 1987†
Occupational				
Whole Working Day	10	10	0.5	5
Short-Term	30[a]	20-30[b]	5[b]	10[b]
For Limbs	—	—	25	25
General Public				
Up to 24 Hours Per Day	5[c]	5	0.1[c]	0.2
Few Hours Per Day	10[d]	10	1[d]	—

Notes: (a) Short-term occupational exposure to rms electric field strengths between 10 and 30 kV/m is permitted provided the rms electric field strength (kV/m) times the duration of exposure (hours per workday) does not exceed 80 for the whole working day.
(b) Maximum exposure duration is 2 hours per workday.
(c) This restriction applies to open spaces in which members of the general public might reasonably be expected to spend a substantial part of the day, such as recreational areas, meeting grounds and the like.
(d) These values can be exceeded for a few minutes per day provided precautions are taken to prevent indirect effects.

* To convert from mT to G, multiply by ten; to convert to mG, multiply by 10,000.
† Exposure limits specified in an IRPA/INIRC draft dated May 12, 1987 (see *MWN*, M/A88).

Currents Induced by 50/60 Hz Magnetic Fields and Their Bioeffects

- 1-10 mA/m² (induced by magnetic fields above 0.5-5 mT)—minor biological effects have been reported;
- 10-100 mA/m² (above 5-50 mT)—there are well-established effects including visual and nervous system effects;
- 100-1000 mA/m² (above 50-500 mT)—stimulation of excitable tissue is observed and there are possible health hazards; and
- 1000 mA/m² and above (greater than 500 mT)—extra systoles and ventricular fibrillation can occur (acute health hazards).

Electric Field Guidelines

In a report prepared by the IRPA/INIRC for the WHO in 1984, the committee concluded that, "It is not possible from present knowledge to make a definitive statement about the safety or hazard associated with long-term exposure to sinusoidal electric fields in the range of 1-10 kV/m" (see *MWN*, D84). "We are still in the same situation today," Repacholi said.

Nevertheless, the new IRPA guidelines allow continuous public exposures of 5 kV/m for the public and 10 kV/m for workers. "For the general public, the 5 kV/m limit applies to open spaces, like sports grounds, where people might spend a substantial part of the day. When they go indoors, the electric fields would be lower by more than an order of magnitude. For occupational exposure, where the limits apply for the workday only, many lab studies on human volunteers have shown no adverse effects from short-term exposure to electric fields of up to 20 kV/m or magnetic fields of up to 5 mT," Repacholi explained.

The IRPA guidelines, which went through final editing at the INIRC annual meeting, in Sicily, Italy, in mid-May, will be published in *Health Physics* in late 1989 or early 1990. They will also appear in a special book on INIRC guidelines and publications to be released later this year.

The guidelines will not be available until publication. For more information, contact: Mme. A. Duchêne, 32 rue Gambetta, F-92260 Fontenay-aux-Roses, France.

WI PSC Initiative for "Independent" EMF Research

The Wisconsin Public Service Commission (WI PSC) is seeking an independent national research effort on the health effects of electromagnetic fields (EMFs). In a March 13 letter to the 49 other state utility commissions, the three Wisconsin commissioners urged the development of an "adequately funded" program to quickly resolve "what is clearly an important issue that needs to be resolved."

A key goal of the WI PSC plan is to make the research program credible by freeing it of direct utility influence. To that end, the WI PSC proposes two potential approaches: either to persuade the Electric Power Research Institute (EPRI) that all or part of its EMF research funding be managed independently, with advice from utilities and state PSCs, or to set up an interstate body, patterned after the New York State Power Lines Project (NYPLP). The commissioners suggest that the National Association of Regulatory Utility Commissioners (NARUC) or a group of "interested states" should develop the new program.

The Wisconsin initiative comes at a time when many state legislatures, in response to public pressures, are considering or sponsoring their own research (see *MWN*, M/A89). The WI PSC notes that a joint approach would be more productive.

Wisconsin has already received encouragement from some of the more active state utility commissions. In an April 25 response, New York PSC Commissioner Peter Bradford agreed that "one of [the] first steps should be to have NARUC urge EPRI to restructure part of its EMF research to assure independence." He also pointed out that the NY Department of Health had already proposed a number of "independently-managed health studies" as a follow-up to the NYPLP (see *MWN*, N/D88).

The California Public Utilities Commission (CA PUC) has sent a "statement of general support" for state-coordinated research, CA PUC's Clyde Murley told *Microwave News*. "We welcome any approach that would increase efficiency," he said. Murley added that the CA PUC shares the WI PSC's concerns about funding, credibility and timeliness of research results.

The CA PUC is currently working on its own literature review of health effects research, in cooperation with the state Department of Health Services. The report should be out in mid-September (see *MWN*, N/D88 and M/A89).

The WI PSC initiative was developed by Michael John Jaeger. For more information, contact Jaeger at: PSC of Wisconsin, PO Box 7854, Madison, WI 53707, (608) 267-2546.

Seattle City Light (SCL), a Washington state utility, would also like to see more EMF research that is "independent of industry interests." In an April 10 letter to U.S. Representative Norman Dicks (D-WA), SCL Superintendent Randall Hardy called for Congressional support for a national EMF effects program to be developed by an interagency coordinating group, and for a fiscal year 1990 Department of Energy EMF budget of $4 million (see p.5).

Hardy pointed out that although EPRI plans to spend approximately $6 million on EMF effects research this year, "These efforts will never...replace the contribution of an independently run federal research program."

HL&P v. Klein Case Is Over

The Texas Supreme Court has again refused a motion by the Klein Independent School District for a rehearing on the reversal of its $25 million punitive damage award from Houston Lighting and Power (HL&P).

In 1985, Klein won the landmark judgment when a jury found that the utility had built a 345 kV power line across school property without obtaining proper permission (see *MWN*, N/D85). The damages were struck down by the Texas Court of Appeals in 1987 and the state Supreme Court first refused to review the case last summer (see *MWN*, N/D87 and J/A88).

Dixon Montague of Vinson & Elkins, a Houston law firm representing Klein, said the case is over. "There's nothing else we can do," he told *Microwave News*. HL&P had filed its own motion for a rehearing, but the request was conditional on the court's agreeing to hear Klein's motion, according to Harris Leven, an HL&P attorney.

Australians Take Cancer Risk Seriously

Government and industry researchers in Australia are taking the cancer threat associated with electromagnetic fields (EMFs) very seriously, as indicated by the two papers discussed below:

Call for a 15-30 mG Magnetic Field Limit

Until definitive results are in, magnetic fields from new power lines should not exceed the average levels surrounding existing 220 kV lines—15 to 30 mG, Dr. Ken Joyner of Telecom Australia Research Laboratories in Clayton, Victoria, recommends.

Joyner's survey of EMF bioeffects is one of the first reviews by a researcher—especially one working for industry—to call for specific magnetic field limits to protect against cancer risks.

Discussing the epidemiological literature, Joyner points out that, although some studies have been "soundly criticized," an EMF-cancer association "deserves serious consideration given the ubiquitous nature of exposure to the electricity distribution system and to AM/FM radio and TV broadcast signals." He further notes that the levels "implicated" in those studies indicating increased cancer risks are "readily found in our homes and environments."

Having reviewed *in vitro* experiments, including those by Drs. Takuya Akamine, Craig Byus and Jerry Phillips, Joyner observes that extremely low frequency (ELF) fields may be "growth enhancers" of malignant tissue cultures and may cause transitory suppression of cell-mediated immunity.

In his paper, Joyner also considers the role of the earth's geomagnetic field and proposes a model to explain the mechanism for the interaction of ELF EMFs at cell membranes.

Joyner calls for the support of further research: "Certainly the recommendations of the WHO/IRPA [World Health Organization/International Radiation Protection Association] committee concerning the 'urgent need' for studies to resolve the suspected link between ELF magnetic fields and cancer should be fully supported by those agencies responsible for the funds for research" (see *MWN*, M/A87).

"[ELF] Electromagnetic Radiation and Interactions at the Cell Membrane" appears in *Radiation Protection in Australia, 6*, pp.118-125, October 1988. Joyner can be reached at: Telecom Australia Research Laboratories, 770 Blackburn Road, Clayton, Victoria 3168, Australia.

A Critical Evaluation of the Literature

Dr. Vincent Delpizzo, a member of the Australian Radiation Laboratory's Non-Ionizing Radiation Group, will soon publish a critical review of the ELF cancer literature, in which he concludes:

> There is enough evidence at present to justify further investigation of this subject. Although exposure to ELF [fields] is an inevitable part of the lifestyle in any technologically advanced society, the degree of this exposure could be reduced, sometimes simply and inexpensively, if health considerations warranted it. The vagueness of the *in vitro* results is not unprecedented in a complex and little understood area.

Delpizzo finds that the "epidemiological data show a reasonable degree of consistency." With respect to the residential studies, he observes that the "available data indicate that a strong association [between ELF fields and cancer] does not exist, but there is some reason to believe that this is partly due to misclassification of exposure." He also notes that 19 of 23 occupational studies have reported an increase in some form of cancer—in nine cases, leukemia.

Delpizzo provides an unusually frank analysis of the ongoing debate over the latest epidemiological and laboratory results. For instance, he dismisses many of the arguments put forward by Dr. Philip Cole of the University of Alabama in Birmingham as "trivial" and "naive." Delpizzo calls Cole's conclusion that the Wertheimer-Leeper study was biased "unproven and unconvincing."

"An Evaluation of the Existing Evidence on the Carcinogenic Potential of [ELF] Magnetic Fields" will appear in the June 1989 issue (*Vol.12*, No.2) of *Australasian Physical and Engineering Sciences in Medicine*. Delpizzo can be contacted at: Australian Radiation Laboratory, Lower Plenty Road, Yallambie, Victoria 3085, Australia.

Around the United States...

Florida...Three Boca Raton parents went to court on May 15 to shut down the Sandpiper Shores Elementary School, located within 230 feet of five power lines in Palm Beach County (see *MWN*, J/F89). A decision from the judge is expected in the first half of June. The experts who testified for the parents were: Drs. Harris Busch, Andrew Marino, Jerry Phillips and Stephen Smith. Testifying on behalf of the school board were: Drs. Edwin Carstensen, Philip Cole, Fred Dietrich, William Feero, Dwight Mercer and Morton Miller. A number of the experts appeared on videotape.

Florida...The Hillsborough County Attorney's office has temporarily withdrawn its petition challenging the state's new electric and magnetic field limits of 2-10 kV/m and 150-250 mG, respectively (see *MWN*, M/A89). The case is now being handled by outside attorneys, Chief Assistant County Attorney Elliott Dunn told *Microwave News*. Dunn expects the petition to be re-filed "any day now."

Maine...Bill No.1347, which would have imposed interim electric and magnetic field standards of 1 kV/m and 3 mG, re-

spectively, for new power lines and which would have required the Public Utilities Commission (PUC) to consider techniques for reducing power line magnetic fields and to review research on health risks associated with EMF exposure, has been withdrawn by its sponsor, Representative Conrad Heeschen. The PUC is now willing to collect data on health effects and magnetic field mitigation and to serve as a resource center, Heeschen told *Microwave News*—although the PUC's approach is not as "active" as he would have liked. With regard to future legislation, Heeschen said that he will first "monitor what the PUC is doing and then go from there." At a May 10 public hearing prior to the bill's withdrawal, Arthur Adelberg, a Central Maine Power Co. (CMP) vice president and general counsel, testified that the utility supported the research efforts, but was opposed to the interim limits, calling them "unwarranted," "premature" and "severely disruptive to economic development of this state." CMP submitted a new draft of the bill without the standards and with a provision for a PUC-appointed panel of experts to assist the commission. Dr. William Bailey, Dr. Philip Cole and Michael Silva also appeared as expert witnesses for CMP. Silva presented a chart which chronicled the magnetic field levels he encountered on the way to the hearing room through the streets of Augusta, ME. The chart showed that the state legislature's usual hearing room measured magnetic field levels of about 25 mG; the local Burger King measured over 10 mG.

Oregon...Interim electric and magnetic field limits of 1 kV/m and 2 mG, respectively, will most likely be dropped from Bill No.2932 until the results of proposed health studies have come in, according to Marc Overbeck, an aide to Representative Nancy Peterson, the bill's sponsor (see *MWN*, M/A89). In a telephone interview, Overbeck explained that a number of projects proposed by the Department of Health Services are being considered, although Peterson favors a combined research and literature review package which would cost $124,000; Overbeck conceded, however, that budget shortfalls make such an allocation highly unlikely. Overbeck added that the review would cover all forms of non-ionizing electromagnetic radiation, while the research would focus on the lower end of the frequency spectrum—for example, a study involving electric blankets, heating sources and home appliances.

November DOE-EPRI Review Will Be Held in Portland, OR

This year, the annual review of research sponsored by the Department of Energy and the Electric Power Research Institute (DOE-EPRI) on the bioeffects of extremely low frequency electromagnetic fields will be held in Portland, OR, November 12-16.

The meeting, which will feature paper presentations and poster sessions, is open to the public and there is no registration fee. The Westin Benson Hotel is offering special room rates of $50.00 to attendees.

For more information, contact: W/L Associates, 120 W. Church St., Frederick, MD 21701, (301) 663-1915.

Texas...On May 25, the Austin City Council adopted a resolution instructing the City Manager: (1) "to develop a transmission plan which meets the long-term needs of the [Lower Colorado River Authority] to maintain reliable service while at the same time [minimizing] the potential health effects of [EMFs] from the proposed transmission lines"; and (2) to make sure that if any lines of greater than 138 kV are proposed, "it must be demonstrated that the [EMFs] generated by said lines are no greater than the fields generated by 138 kV lines with the same capacity." The day after the vote, the *Austin American Statesman* applauded the council's recognition of "physical and fiscal reality." Less than two years ago, the council voted to scrap a proposed 345 kV line.

Washington...State bill No.5275, which would require a literature review of ongoing EMF studies, no longer calls for a $10,000 appropriation (see *MWN*, M/A89). If approved, the Washington State Institute for Public Policy, a state-run organization, will conduct the survey with funding from its own budget.

UPDATES

COMPATIBILITY & INTERFERENCE

Surge Protection... KeyTek Instrument Corp. has issued three resources on surge testing: The eight-page *Application Note 103* describes equipment and methods for surge testing all types of electronic equipment and the various relevant industrial, national and international specifications. *Application Note AN-121* provides detailed information on high-voltage oscilloscope probes and techniques for measuring surge voltages up to 6 kV. And the second edition of the 68-page *Surge Protection Test Handbook* includes instructions on how to test equipment and refers to applicable standards. Single copies of these items are available free from: Mike Hopkins, KeyTek Instrument Corp., 260 Fordham Rd., Wilmington, MA 01887, (508) 658-0880.

EMP

Strom, the Courts and *60 Minutes*...Procedural questions—rather than the substantive issues—are now dominating the case of *Robert Strom v. Boeing*. Strom, a former Boeing EMP technician who developed leukemia, charges that Boeing was aware that EMP exposures can cause cancer, but failed to warn any of its employees or to take precautions to protect them (see *MWN*, J/A88 and S/O88). Most recently, Boeing

filed a petition to move the case to federal court (it was originally filed in the King County, WA, Superior Court). Strom countered with a May 22 petition to send the case back to state court. Strom is also asking that attorneys' fees and costs be imposed against Boeing for its "frivolous petition." Strom's planned videotaped deposition, which is intended to stand as permanent evidence in the event that Strom is incapable of testifying at the trial, is now on hold until the jurisdiction dispute is decided....Meanwhile, in the April 1989 *IEEE Antennas and Propagation Society Newsletter*, Editor W. Ross Stone takes aim at the March 5 *60 Minutes* segment on the Strom class action suit (see *MWN*, N/D88). Stone, who worked at the Cascade, MT, EMP test site in the late 60s and early 70s, calls the CBS news program a "personal shock" and says that potential harmful effects of EMP exposure were actively debated while he was at the site. "To the best of my knowledge, without significant exception, it was then and is now generally accepted within the EMP community that exposure to such fields per se does not represent a health hazard," Stone notes. He points out that improperly shielded EMP pulsers can emit X-ray radiation. With regard to *60 Minutes*' coverage, Stone comments that, "It is unfortunate that there apparently was little electromagnetic or bioelectromagnetic expertise involved in the investigative—and obviously provocative—reporting." He calls for those with scientific information on EMP effects to write to him so that it can be "shared with our newsletter readers." Contact Stone at: Stoneware, Ltd., 1446 Vista Claridad, La Jolla, CA 92037, (619) 459-8305. For a transcript of the segment, contact: *60 Minutes* Transcripts, 267 Broadway, New York, NY 10007, (212) 227-7323.

MEASUREMENT

Near-Field Standard... The IEEE EMC Society's Working Group P-1140 has expanded its mission and will now develop a standard for measuring electric and magnetic fields (EMFs) near all types of sources. Originally, the group had limited itself to a protocol for measuring EMFs around VDTs (see *MWN*, J/A87 and M/A88). The decision to write a general near-field standard was reached at a P-1140 meeting on April 7 at AT&T Bell Labs in Murray Hill, NJ. According to Ric Tell, the new chairman of the working group, a consensus emerged at the meeting on the need for a single document to give guidance on how to do near-field measurements, rather than for a source-specific standard. The working group plans to have a draft standard within a year. Don Heirman and Ron Petersen, both of Bell Labs, Walt Baker of IBM, David Mertz of UL and Dr. Motohisa Kanda of NIST (NBS) were also at the meeting. Tell, a consultant based in Las Vegas, NV, took over the chairmanship from Stephen Berger of Electro-Mechanics and Jim Greeson of IBM.

New VDT and ELF Meters...A portable VDT magnetic field meter that allows measurements to be taken according to Swedish protocols, is now available in the U.S. Combinova AB, a Swedish company, is manufacturing the unit and Ergonomics, Inc., a Southampton, PA, firm specializing in product safety, is distributing it in the U.S. The Magnetic Field Meter 1000 (MFM 1000), which weighs 6.6 pounds, can measure VDT magnetic fields in the 1 kHz-400 kHz frequency range, as well as the time rate of change of the magnetic field. Each measurement takes less than two seconds. A calibration device (MFG 250) is also available. The MFM 1000 costs approximately $8,000. When purchased with the meter, the MFG 250 costs $900. (The prices vary with international exchange rates.) Combinova will soon introduce a new meter to measure power frequency magnetic fields. The MFM 10 will be portable and has been designed for both single measurements and for surveys. Pricing information for the MFM 10 was not available at press time. For more information, contact: Frances George, Ergonomics, Inc., PO Box 964, Southampton, PA 18966, (215) 357-5124. In Europe, contact: Combinova AB, Box 20050, S-161 20 Bromma, Sweden, (8) 733 93 10.

MEDICAL APPLICATIONS

Hyperthermia Device Implant... The Los Alamos National Laboratory and the Department of Energy are soliciting requests from companies interested in participating in the joint development and licensing of a surgically-implanted "diathermic" device. According to a notice in the April 17 *Commerce Business Daily*, the device, which was developed at the Los Alamos Lab, provides a mechanism for treating deep tumors without invasive techniques, and eventually may be used for bone healing. Once the device is in place, an external antenna is aligned with the implanted one to induce current in the tumor. Since it does not require a power source, the device can remain in place "indefinitely." For more information, contact: Janis Rhoades, Industrial Applications Office, Los Alamos National Lab, M/S M899, PO Box 1663, Los Alamos, NM 87545, (505) 667-3839.

Treating Cancer With Electricity... Dr. Björn Nordenström of the Karolinska Institute in Stockholm, Sweden, described his work on biologically closed electric circuits in a paper presented at the American Cancer Society's (ACS) *31st Annual Science Writers' Seminar* in Irvine, CA, on April 2. Nordenström's "electrochemical treatment" involves inserting an electrode in a tumor and another in the surrounding tissue and inducing a low voltage current between them. Some experts are skeptical about Nordenström's unorthodox procedure. But Dr. Gerald Murphy, ACS's vice president for medicine, said that Nordenström's basic research is "impeccable," the April 11 *Washington Post* reports. For the most part, Nordenström's treatments have been limited to lung and breast cancer patients who have not responded to traditional treatments. Of over 100 patients treated, only two are still alive and cancer-free, according to the *Washington Post*, but Nordenström emphasizes that his patients' cancers were in advanced states of development. "I got only very, very poor cases, where no

other therapy was available," Nordenström was quoted in the April 1986 *Discover* magazine cover story (see *MWN*, M/A86). He points out in his paper that "other patients have shown regression of treated cancers but died...from non-treated tumors." He adds that patients who have undergone surgery or radiation therapy may not be good candidates for his method, because such procedures create scar tissue which can "insulate" the tumor. Nordenström was also featured on the October 21, 1988, edition of ABC-TV's *20/20*.

MEETINGS

NCRP 1986 Symposium... The proceedings of the April 1986 annual meeting of the National Council on Radiation Protection and Measurements (NCRP), *Non-Ionizing Electromagnetic Radiations and Ultrasound*, have been published. The 384-page volume includes the text of Dr. Herman Schwan's Taylor Lecture, as well as papers by Drs. Ross Adey, Ed Alpen, Tom Budinger, H.B. Graves, Bill Guy, Don Justesen, Bill Kaune, Mary Ellen O'Connor and Tom Tenforde. Also included are updates—as of 1986—of the various NCRP committees working on non-ionizing radiation issues (see *MWN*, J/F86). The chairman of the NCRP program committee was George Wilkening of AT&T Bell Labs. A copy of NCRP Proceedings No.8 is available for $28.00 from NCRP Publications, 7910 Woodmont Ave., Bethesda, MD 20814, (301) 657-2652. Note that those who have standing orders for NCRP publications will not receive this volume unless it is specifically ordered.

Medical Applications... The University of Tulsa and the FDA's Center for Devices and Radiological Health sponsored a conference on *Emerging Electromagnetic Medical Technology* at the university, May 25-28. Invited U.S. and European scientists reviewed well-known applications such as hyperthermia, diapulse and magnetic resonance imaging, as well as those applications still under development, such as using microwaves for warming and using PEMFs for nerve excitation. Issues of risk assessment and FDA approval were also addressed. For more information, contact: Professor Mary Ellen O'Connor, University of Tulsa, 600 South College Ave., Tulsa, OK 74104, (918) 592-6000.

Swedish NIER Proceedings... Papers presented at the *1st Symposium on the Biological Effects, Hazards and Protection from Non-Ionizing Radiation in Outdoor Applications*, held in Stockholm in August 1987, appear in the May 1989 issue of *Health Physics*. Most of them address laser radiation; there are four on RF/MW radiation (see Occupational Health at right). This special issue of the journal was edited by David Sliney of the U.S. Army Environmental Hygiene Agency.

MILITARY SYSTEMS

PAVE PAWS and the Shuttle... Georgia's *Macon Telegraph and News* reports that when the NASA space shuttle Atlantis made a surprise visit to Robins AFB on May 15, the USAF turned off its PAVE PAWS radar. The Atlantis was attached to a modified Boeing 747 and was accompanied by NASA aircraft. The Macon newspaper quoted a USAF spokesman as saying that Robins officials were unsure as to whether the planes were carrying electro-explosive devices (EEDs): "So that's why we took the safety precautions." The Georgia PAVE PAWS was built near one of the Robins AFB runways, prompting fears that EEDs aboard aircraft flying through the radar's main beam might be detonated (see *MWN*, J/A88, N/D88 and J/F89).

HPMs are "Critical"... In a March 15 report to Congress on critical technologies, the DOD lists 22 areas that are vital to "ensuring the long-term superiority of U.S. weapon systems." Among these are high-power microwaves (HPMs), sensitive radars, phased arrays, pulsed power and hypervelocity projectiles. The report predicts that the DOD-DOE HPM program, with a $50 million R&D budget for FY1990, will, over the next decade, increase the energy per pulse from 100 to 10,000 joules. It also cites the problem of electronic disruptions caused by HPMs: "Fratricide from friendly HPM systems is...a serious concern." According to the *Critical Technologies Plan*, the U.S. lags behind the U.S.S.R. in the development of certain types of HPM oscillators; "several allied nations" also have their own military HPM programs. The annual report was submitted to the Congressional Committees on Armed Services, as ordered by the National Defense Authorization Act for Fiscal Year 1989.

OCCUPATIONAL HEALTH

CNS Effects Among Radar Workers... In 1985, there was a flurry of news reports from Dr. Hans-Arne Hansson's laboratory at the University of Göteborg in Sweden: He announced that he had found that radar workers develop abnormal protein patterns in their cerebrospinal fluids (see *MWN*, My85). After a long silence, Hansson and six associates have now described these central nervous system (CNS) findings in a brief paper appearing in the May issue of *Health Physics*. An examination of 17 radar mechanics and 12 unexposed controls—all in their early 50s—indicated no differences in "pathological neurological findings" or in "psychometric tests" and "psychiatric rating scales," but did find that the "frequency of the occurrence of an increased protein band with an isoelectric point of 4.5 in the cerebrospinal fluid was higher among the men exposed to microwaves than among the referents." The team adds that, "The nature and clinical significance of this or these proteins are still unclear." The workers were exposed to radars which emit 1-10 GHz. The researchers found that the time rate of change of the magnetic field associated with some of the older transmitters was "surprisingly high"—up to 350 T/s. The lead author of the paper is Dr. Ralph Nilsson.

Radiation Accident... On February 3, 1986, nine Telecom

Australia workers were accidentally exposed to 4.1 GHz radiation. Two of the men, who were within two meters of the waveguide, were exposed to approximately 4.6 mW/cm^2 for up to 90 minutes—a level which exceeds the Australian exposure standard. The other seven men were exposed to less than 0.15 mW/cm^2. According to an account of the accident in the *Journal of Microwave Power and Electromagnetic Energy* (*Vol.23*, No.2, 1988), the whole-body average specific absorption rate (SAR) for the two men most exposed was estimated to be 0.13 W/Kg and the SARs for the eyes and the skin were calculated to be 3.8-4.8 W/Kg and 3.8 W/Kg, respectively. Drs. B. Hocking and K. Joyner of Telecom Australia and Dr. R. Fleming, a general practitioner, state that the two men reported a loosening of their scalp hair. Ophthalmological examinations found some changes, though they were not consistent. One of the two men reported continuing behavioral problems, including irritability and insomnia. A psychological assessment performed the following May found normal mental function, however. The blood pressures of all nine men were normal, as were their pituitary functions. The authors conclude that the exposure "has not resulted in harmful effects." (For reports on other accidents, see *MWN*, N83, D84, J/A86 and J/F88.) In a companion paper appearing in the same issue of the journal, the two Telecom staffers propose a protocol for assessing health effects following an RF radiation accident.

PEOPLE

In April, **Richard Tell,** a consultant based in Las Vegas, NV, was among those elected to a six-year term as a member of the National Council on Radiation Protection and Measurements (NCRP). Outgoing members include Drs. **Tom Budinger** of the Lawrence Berkeley Lab and **Joe Elder** of EPA. Most of the council's 73 members specialize in ionizing radiation; those members with expertise in non-ionizing radiation whose terms are continuing include: Drs. **Bill Guy** of the University of Washington in Seattle, **Leonard Sagan** of EPRI, **Tom Tenforde** of Battelle and **George Wilkening** of AT&T Bell Labs....**Dave Janes,** a division director in EPA's Office of Radiation Programs who oversees the agency's non-ionizing radiation efforts, has announced that he will retire later this summer—just before EPA phases out its NIER program on September 30, the end of the fiscal year....**Eb Tingley,** a vice president of engineering at the Electronic Industries Association's Consumer Electronics Group, has retired. Tingley was long active in EMI issues and shared an Emmy award for the development of stereo television....**Frank Borghetti** has been appointed vice president of marketing and sales for Electro-Metrics, of Amsterdam, NY, which makes EMC and TEMPEST products....On April 1, **Liliane Volcy** of the FCC's Office of Engineering and Technology died unexpectedly. Volcy worked on the commission's EMI rules and was active in CISPR deliberations.

STANDARDS

ANSI on EMI Measurements...ANSI C63 has published four new EMC standards: (1) *Electromagnetic Compatibility—Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 10 kHz to 1 GHz—Methods of Measurement,* ANSI C63.4-1988 ($46.00); (2) *Electromagnetic Compatibility—Radiated Emission Measurements in Electromagnetic Interference (EMI) Control,* ANSI C63.5-1988 ($48.50); (3) *Electromagnetic Compatibility—Open Area Test Site Measurements—Guide for the Computation of Errors,* ANSI C63.6-1988 ($7.50); and (4) *Guide for Construction of Open Area Test Sites for Performing Radiated Emission Measurements,* ANSI C63.7-1988 ($50.00). Copies of all four standards are available, prepaid, from: Sales Department, ANSI, 1430 Broadway, New York, NY 10018.

CISPR and IEC Draft Rules...CISPR has released five six-month draft rules amending CISPR Publication 14, *Limits and Methods of Measurement of Radio Interference—Characteristics of Household Electrical Appliances, Portable Tools and Similar Electrical Apparatus,* CISPR/F(Central Office)56-60 ($51.00). CISPR has also issued a draft of the second edition of CISPR Publication 13, *Radio Interference—Sound and Television Broadcast Receivers and Associated Equipment—Limits and Methods of Measurement of Interference Characteristics,* CISPR/E(Central Office)45 ($22.00)....And the IEC has released a draft amendment (No.2, September 1988) to *Disturbances in Supply Systems Caused by Household Appliances and Similar Electrical Equipment, Part 2: Harmonics,* IEC 555-2: 1982 ($6.00). In addition, the IEC has issued a five-part six-month draft rule, *Loading and Strength of Overhead Transmission Lines,* 11(Central Office)28 I-V ($100.00). Copies of all proposals are available, prepaid, from ANSI's International Sales Department at the address above.

TECHNOLOGY

FAA Inaugurates the MLS... The new microwave landing system (MLS), which has been plagued by delays, reached an important milestone in April when the FAA inaugurated the first U.S. commercial MLS at the Lebanon, NH, airport. An MLS has been in operation at the FAA Technical Center in Atlantic City, NJ, since March 1988. Hazeltine, the prime contractor for the MLS (see *MWN*, J/F84), is more than three years behind schedule, due to software development problems. According to the FAA, a key advantage of the MLS over the instrument landing system (ILS) now in use is that the MLS's curved landing approach gives pilots more than one incoming route from which to choose. The ILS, on the other hand, requires planes to line up for straight-in approaches. Another ILS limitation is its narrow frequency band, just above the 108-112 MHz FM band, which, in turn, makes it vulnerable to EMI from powerful FM radio antennas—

though some experts contend that there is enough spectrum space to meet the needs for new ILSs. The FAA's National Airspace Plan calls for 960 MLS installations at U.S. airports by the year 2000. The American Transport Association (ATA), however, remains skeptical: "It's not clear that the MLS is ready to replace the ILS; much of what was anticipated for the MLS hasn't been proven yet," ATA's Walt Coleman told *Microwave News*. Until then, ATA members are reluctant to pay the estimated $100,000-$250,000 to outfit a plane with an MLS receiver. The FAA and the ATA are currently engaged in a nine-part evaluation of the need for and capabilities of the MLS (see *MWN*, N/D88). Among the other airports slated to receive the MLS in the near future are Logan International Airport in Boston, MA, and one in Manchester, NH, according to the April 7 *New York Times*.

Prospecting for Oil and Gas... The February 1989 issue of the *Proceedings of the IEEE* has a special section on "Electromagnetic Prospecting for Oil and Gas." It features four invited papers and an introduction by Dr. Richard Sigal of Amoco Production Co. in Tulsa, OK.

VDTs

Low Magnetic Field VDTs in the U.S.... Tandberg Data, Inc., a Norwegian company, is the first to market in the U.S. a line of cathode ray tube (CRT) displays designed to control VLF magnetic fields. A number of companies, including IBM, have been selling VLF-shielded terminals in Scandinavian countries, but these have not been available in the U.S. In addition, the Boston-based Safe Computing Company has introduced a flat liquid crystal display (LCD) shielded to eliminate exposure to ELF magnetic fields. LCDs do not emit VLF fields, but some ELF electromagnetic fields can be emitted by the fluorescent back-lighting. The power transformer for the computer itself is placed on the floor, away from the operator, and the power cable is also shielded. The VLF magnetic fields emitted by the Tandberg displays are well below the guidelines adopted by Swedish government agencies. The time rate of change of the Tandberg's VLF magnetic fields (dB/dt) is approximately 3 mT/s—it varies slightly among the different models—and the magnetic field strength is less than 10 nT (both measured at 50 cm from the terminals). Their electrostatic fields (equivalent surface potential) are less than ±500 V. Tandberg notes that the picture tube was redesigned to meet the Swedish limits of 25 mT/s and 50 nT (see *MWN*, S/O88), and then the VLF fields were further reduced with "active compensation coils"—that is, by partially canceling out the remaining magnetic fields. The company has applied for a patent on its "radiation reduction kit," Tandberg's Michael Tierney told *Microwave News*. When the coils are installed, they do not affect picture quality, he said. The prices of the Tandberg terminals were not available at press time, but Tierney said that they are competitive with other units that do not reduce VLF fields. The "Safe Monitor" was tested for radiation emissions by two independent laboratories. Chomerics, Inc. and Dayton T. Brown, Inc. found no measurable levels of radiation exposure at user distances, according to George Lechter, the founder and president of Safe Computing. "We shielded everything from 60 Hz up to 100 GHz," he said. Lechter added that, according to his measurements, some LCDs had "surprisingly high" electromagnetic fields. Safe Computing cites studies that link VDT work to reproductive risks as a cause for concern and targets the unit at women of child-bearing age. The Safe Monitor costs $995. For more information on Tandberg terminals, contact: Michael Tierney, Tandberg International, Inc., 1 Labriola Court, PO Box 99, Armonk, NY 10504, (914) 273-6516 or Tandberg Data A/S, PO Box 9 Korsvoll, N-0808 Oslo, Norway, 47 2 18 9090. For more on the Safe Monitor, contact: George Lechter or Allen Nitschelm, Safe Computing Co., 368 Hillside Avenue, Needham, MA 02194, (800) 222-3003 or (617) 444-7778.

RCA Pays $250,000 Settlement *(continued from p.1)*

The expert witnesses who testified for Mrs. Yannon on the health effects issue included Dr. Martin Geller, chief of neurology at Elmhurst General Hospital in Queens, NY, and Dr. Alfredo Santillo, a general practitioner based in Staten Island.

In 1980, Mrs. Yannon won a workers' compensation suit against New York Telephone Co. for $29,000 plus $48 a week for life. The decision was later upheld on numerous appeals. In 1982, the Appellate Division of the New York Supreme Court unanimously ruled that there was "substantial evidence to establish the necessary causal relationship" between exposure to microwave radiation and occupational disease resulting in death (see *MWN*, A81, Ju82, J/A82 and N82).

Samuel Yannon worked on microwave relay equipment for 15 years at the phone company's Television Transmission Facility, located on the 87th floor of the Empire State Building. In 1968, Yannon, who was then 57 years old, began to suffer a drastic deterioration of his eyesight, hearing and coordination. He was transferred to another site in 1969 and was later forced to retire for medical reasons in 1971 after 42 years with the company.

Yannon died in 1974 at the age of 62. In his final months, he lost almost all sight, memory, speech and motor coordination. Santillo, who was Yannon's physician from 1970 to 1973, diagnosed him as having suffered from "chronic brain syndrome with psychotic overtones due to biological brain changes resulting from prolonged exposure to short wave radiation."

In 1976, Mrs. Yannon filed her $3.5 million suit against RCA, the manufacturer of the relay equipment, in the New

York State Supreme Court, Richmond County, for breach of warranty, negligence and wrongful death. The product liability case was dismissed in 1982 on a pre-trial motion by RCA, which claimed that the three-year statute of limitations had passed when the suit was filed (see *MWN*, J/A82).

The decision was reversed on appeal in 1984, after Mrs. Yannon maintained that her husband was already suffering from "chronic brain syndrome" in 1968 (see *MWN*, Ju84). In cases of mental incapacity, the statute of limitations is suspended, Albert explained. RCA appealed again and was turned down once more (see *MWN*, J/A85).

After she had won the statute of limitations issue, RCA asked Mrs. Yannon to settle. Her attorneys urged her to accept, because a trial would still have been a few years away.

Karen Hymowitz of Bower & Gardner in New York City, which represented RCA in the suit, told *Microwave News* that she could not comment on the case. After Mrs. Yannon filed suit, RCA was taken over by General Electric Co.

Workers' Compensation Award

At the first appeal by New York Telephone of the 1980 workers' compensation award, Dr. Milton Zaret, a Scarsdale, NY, ophthalmologist and an expert on the effects of non-ionizing radiation, testified that Mr. Yannon had suffered an extreme case of microwave or radiowave sickness, which ultimately resulted in his death.

Dr. Sol Michaelson of the University of Rochester, NY, testifying on behalf of the phone company, said that there was no reason to believe that a cause and effect relationship existed between Yannon's condition and microwave radiation exposure. Captain Paul Tyler, a Navy doctor, also testified against Yannon.

Also appearing as an expert witness for New York Telephone was Dr. Robert Herndon of the University of Rochester, NY, who stated that Yannon suffered from pre-senile dementia, probably Alzheimer's disease, among other ailments, and that there were no data indicating a link between microwave exposure and his condition. But at a 1986 hearing convened by the Environmental Protection Agency, Dr. Sam Koslov of the Johns Hopkins University Applied Physics Lab in Laurel, MD, presented experimental results showing that a monkey exposed to microwave radiation developed neurofibrillary tangles, one of the classic signs of Alzheimer's disease. He hypothesized that the tangles may be related to microwave-induced leakage through the blood-brain barrier (see *MWN*, S/O86).

The workers' compensation panel upheld the original ruling in February 1981 and found that, "There was a direct causal relationship between [Yannon's] exposure to microwave radiation during his employment and his subsequent disability, all of which ultimately resulted in his death." It further ruled that Yannon "sustained an occupational microwave radiation disease...and that his death was causally related to his occupation." The decision was once again upheld on appeal in 1982.

BC Hydro's Purchase Offer (continued from p.1)

be energized on July 31.

In a letter dated May 9, Chris Boatman, BC Hydro vice president for corporate affairs and executive assistant to the chairman, informed property owners along the existing ROW that the utility was willing to purchase their land, even though "there is no reason to believe that exposures to [EMFs] pose a risk to human health." The deadline for accepting the offer was May 31.

"It's a real victory for us," Darlene Kavka of Courtenay, BC, who has been fighting for property compensation or an alternate route for the line, told *Microwave News*. "I take my hat off to BC Hydro for taking this issue seriously," she said. The ROW crosses Kavka's property.

BC Hydro sent letters to landowners with easements and/or whose property lies within 165 feet (50 m) of the edge of the ROW, Peter McMullan, BC Hydro's manager of corporate affairs, said in a telephone interview. The utility received 153 responses—90% of those eligible indicated an interest in the purchase offer, he said. And Kavka said, "I know of only six people who are staying. I would not risk living near the lines."

The utility still believes that, after some careful thought, the homeowners will change their minds, McMullan said. BC Hydro is asking all who accepted the offer if they are certain that they want to sell. "There is now a significant level of hysteria. It's been magnified all out of proportion," he said.

This is the first time BC Hydro, which is based in Vancouver, has encountered the issue of potential health effects from power line EMFs, McMullan explained. "We accept that the current situation will have an impact on future planning," he said, but he stressed that, "This has nothing to do with existing lines."

When asked how other utilities might view the purchase offer, McMullan replied that BC Hydro's first priority is its customers.

BC Hydro measured the EMFs along the ROW and determined which properties would have greater fields when the 230 kV line is energized, McMullan said. For example, Kavka said that the utility projected that the magnetic field level in her home will be between 2.5 and 6 mG when the new line is energized.

Dr. William Bailey of Environmental Research Information (ERI), Inc. in New York City, has been hired to advise the utility on power line health effects. Kavka said that the landowners have asked BC Hydro to bring in an expert of their own choosing—they favor Dr. Andrew Marino of Louisiana State University Medical Center in Shreveport, LA. McMullan said the matter is undecided.

In addition, BC Hydro is providing concerned landowners with literature prepared by ERI which states that the existing power line data "should reassure the public that transmission lines do not jeopardize the health of those who reside in their vicinity."

COMMENTARY

The FDA's Biased View of Electric Blankets

"FDA has found no conclusive evidence that electric blankets are a health hazard, despite claims to the contrary by a recent network television program. The program, 'Killer Electric Blankets,' which aired last February on the Fox Television Network, alleged that the use of electric blankets may be linked with a number of ill effects, including cancer.

"Electric blankets—like many other home appliances, including toasters, vacuum cleaners, and computers—produce low-intensity electric and magnetic fields. For the past decade, FDA and other scientists have been investigating whether magnetic fields affect human health. A study conducted in Colorado in 1979 suggested a relationship between exposure to electromagnetic fields and childhood cancer, but a similar study conducted in Rhode Island did not show such a relationship. And a 1988 study in Los Angeles County found no association between the use of electric blankets and adult leukemia. Animal studies have also proved inconclusive.

"Based on current information, FDA sees no reason for people to stop using electric blankets. FDA will continue its research in this area and will monitor the research of other organizations."

The item above—reprinted in its entirety from the May issue of *FDA Consumer*, the Food and Drug Administration's monthly magazine—was written to reassure the public that there is nothing to fear from electric blankets. The FDA was responding to Fox Television, which may have resorted to tabloid journalism and scared the public. Still, that is no excuse for the FDA to play the same game in reverse. After all, few experts doubt that there are some unsettling questions regarding the advisability of using electric blankets, especially for pregnant women. So why is the FDA trying to cover them up by providing an equally unbalanced picture of the health risks?

When we sought an explanation, an FDA press officer replied that the agency was not granting any interviews on this subject. We persisted and finally a senior official at the FDA's Center for Devices and Radiological Health agreed to talk to us—but only on the condition that he remain anonymous. We'll call him Dr. X.

"We are not comfortable that the epidemiological data is clear that there is an identifiable risk," Dr. X told us. "There is too much inconsistency in the data." He then conceded that the FDA is not doing any research to investigate specific risks associated with electric blankets because it is not a "high priority."

There *are* ambiguities in the data, we agreed, but why did the FDA fail to cite two key papers pointing to a health risk: the 1988 Savitz study, which supports the 1979 Wertheimer-Leeper study pointing to a cancer risk at milligauss exposure levels, and the 1986 Wertheimer-Leeper paper linking the use of electrically heated beds with an increased risk of miscarriage? Could it be that the FDA is too busy to keep up with the literature?

No, Dr. X replied, the agency is aware of these studies, but sees no reason to provide the public with a balanced picture. The *FDA Consumer* item "is not complete in the presentation of data," he said, "Nor was it meant to be....We were countering the Fox broadcast, which was clearly a biased view."

There are now more than two dozen published studies showing a link between electromagnetic fields and cancer. How many more does the FDA need before it is willing to raise a cautionary flag—especially for luxury appliances such as electric blankets? Many experts have long advised against buying a house next to a power line; electric blankets present unnecessary risks that are much more easily avoided.

After talking to Dr. X, we made a round of phone calls to see whether members of the bioelectromagnetics community are using electric blankets. We could not find any users—however, few people were willing to be quoted by name. One FDA staffer—not Dr. X—told us that he recommends that the public "proceed with some degree of caution."

The FDA should take a look at a new booklet prepared by researchers at Carnegie Mellon University in Pittsburgh, PA (see *MWN*, M/A89). Without alarming anyone, they offer some sensible advice: "How could prudent people manage their risks from 60 Hz electric and magnetic fields if they wanted to?...They could put away their electric blanket (or electrically heated water bed) and go back to using regular blankets."*

Fox Television may not have provided a balanced view of the electric blanket problem, but that is no reason for the FDA to fight tabloid journalism with whitewash.

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

*The New York State Department of Health issued its own advisory on electric blankets after the Fox Television news broadcast (see *MWN*, M/A89).

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CONFERENCES

New Listings

July 10-13: **The Neuropharmacology of Serotonin,** Vista International Hotel, New York, NY. Contact: Conference Director, New York Academy of Sciences, 2 East 63rd St., New York, NY 10021, (212) 838-0230.

September 27-29: **EPRI Annual Utility Seminar on EMF Laboratory Research,** Lake Lawn Lodge, Delavan, WI. Contact: Robert S. Banks Associates, PO Box 14574, Minneapolis, MN 55414, (612) 623-4646.

October 2-8: **2nd International School on Electromagnetic Fields and Biomembranes,** Pleven, Bulgaria. Contact: Professor Marko Markov, Dept. of Biophysics and Radiobiology, Sofia University, 8 Dragan Tzankov Blvd., 1000 Sofia, Bulgaria.

October 4-6: **Medical Conference: Health and Medicine at Work in the Electricity Industry,** Barcelona, Spain. Contact: International Union of Producers and Distributors of Electrical Energy Secrétariat, 39, avenue de Friedland, FR-75008 Paris, France, (33) 1 40 42 37 08.

November 12-16: **DOE-EPRI Review of 50/60 Hz Biological Research,** Westin Benson Hotel, Portland, OR. Contact: W/L Associates, 120 W. Church St., Frederick, MD 21701, (301) 663-1915 (see p.9).

December 11-13: **9th Miami International Congress on Energy and Environment (9MICEE),** Miami Beach, FL. Contact: Lucille Walter, Clean Energy Research Institute, University of Miami, Coral Gables, FL 33124, (305) 284-4666.

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February 6-8: **6th Annual IEEE Semiconductor Thermal and Temperature Measurement Symposium,** Sunburst Resort Hotel, Phoenix, AZ. Contact: IEEE SEMI-THERM Symposium, c/o C/S Communications, PO Box 23899, Tempe, AZ 85285, (602) 967-7444.

February 13-15: **14th Symposium on Explosives and Pyrotechnics,** Holiday Inn Crowne Plaza, Burlingame, CA. Contact: E&P Affairs, Franklin Research Center, 2600 Monroe Blvd., Norristown, PA 19403, (215) 666-3026.

February 13-15: **Instrumentation/Measurement Technology Conference (IMTC),** ***Emerging Measurement Technologies,*** Red Lion Inn, San Jose, CA. Contact: Robert Myers, IMTC Conference Coordinator, 1700 Westwood Blvd, #101, Los Angeles, CA 90024, (213) 475-4571.

May 20-24: **1990 International Geoscience and Remote Sensing Symposium (IGARSS '90),** College Park, MD. Contact: Dr. James A. Smith, Code 623, NASA/Goddard Space Flight Center, Greenbelt, MD 20771, (301) 286-7282.

June 11-14: **Conference on Precision Electromagnetic Measurements,** Ottawa, Ontario, Canada. Contact: H. Lacoste, Conference Services, National Research Council of Canada, Ottawa, Ontario K1A 0R6, Canada, (613) 993-9009.

August 28-September 5: **23rd General Assembly of the International Union of Radio Science (URSI),** Praha, Czechoslovakia. Contact: Prof. V. Zima, Institute of Radioengineering and Electronics, Czechoslovak Academy of Sciences, 182 51 Praha 8, Czechoslovakia.

October 4-6: **International Conference on Harmonics in Power Systems,** Budapest, Hungary. Contact: Dr. Andras M. Dan, Budapest Technical University, Dept. of Power Systems, 1111 Budapest, Egry Jozsef u.18., Hungary, 361-666-438.

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MICRO WAVE NEWS

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EPA Staff Classifies ELF EMFs "Probable Human Carcinogens"

Decision Overruled, May Be Reinstated

Analysts at the U.S. Environmental Protection Agency (EPA) have recommended that extremely low frequency (ELF) electromagnetic fields (EMFs) be classified as "probable human carcinogens." Their recommendation was based on a two-year review of the health effects literature—primarily epidemiological studies.

By designating ELF EMFs as probable human carcinogens,* the EPA staff put them in a general class with PCBs, DDT and formaldehyde (see table, p.9).

The EPA staff also recommended that radiofrequency and microwave (RF/MW) radiation be designated as a "possible" carcinogen—in a class with saccharin.

Dr. William Farland, director of EPA's Office of Health and Environmental Assessment (OHEA), which prepared the report, ordered the ELF recommendation deleted in mid-March because of the absence of both a mechanism of interaction and an observed dose-response relationship. The RF/MW classification was also removed.

The document, *An Evaluation of the Potential Carcinogenicity of Electromagnetic Fields*, will now be issued without risk classifications, although it nonetheless concludes that ELF studies of leukemia, lymphoma and cancer of the nervous system among children and workers "show a consistent pattern of response that suggests, but does not prove, a causal link." (The complete text of the report's Summary and Conclusions appears on pp.11-15.)

(continued on p.9)

EPA's Original Conclusion: 60 Hz EMFs are 'B1' Carcinogens

As late as March 12, 1990, the paragraph below concluded the executive summary of the EPA report. A few days later, it was deleted.

"Concerning exposure to fields associated with 60 Hz electrical power distribution, the conclusion reached in this document is that such exposure is a 'probable' carcinogen risk factor, corresponding to a 'B1' degree of evidence that it is a risk factor. This conclusion is based on 'limited' evidence of carcinogenicity [in] humans which is supported by laboratory research indicating that the carcinogenic response observed in humans has a biological basis, although the precise mechanisms [are] only vaguely understood."

ELF NEWS

« Power Line Talk »

Woman's Day has encouraged its large readership to write to **EPA** Administrator **William Reilly** to reinstate the agency's research effort on EMF hazards. In fact, it went so far as to include a clip-and-mail coupon, addressed to Reilly, in its May 22 article, "Should You Be Worried About Electricity?" By the end of the month, EPA had received over 400 letters—not just coupons. After Dan Rather put the EPA cancer report (see p.1) at the top of the *CBS Evening News* on May 21 and the Associated Press and the *New York Times* followed up with their own stories, EPA's radiation office was deluged with calls—a few hundred a day, according to one senior EPA official. A couple of days later, the head of EPRI went to talk to Reilly about EMFs (see p.10). Even without all the publicity, Reilly had to be personally aware of EMFs. He and his family live in Old Town **Alexandria**, VA, two blocks from neighbors who are pressuring Virginia Power to reduce ambient magnetic fields from distribution lines—a controversy featured on ABC's *Nightline* (see *MWN*, J/F90 and M/A90). It's possible that even **President Bush** has now heard about EMFs: one of his sons and his family also live in Old Town.

«« »»

The **Department of Energy** (DOE) will transfer its long-term epidemiological research on **ionizing radiation** to the Department of Health and Human Services—following the recommendations of an independent advisory panel. The Secretarial Panel for the Evaluation of Epidemiologic Research Activities (SPEERA) was set up by DOE Secretary **James Watkins** in June 1989 to suggest ways of improving the credibility of the DOE's epidemiology program. In a March report, the panel called for the move in order to "restore public trust" and "assure independence of investigators." It noted that, "Because the department's role is to promote energy production, there is an inherent potential conflict between immediate production goals and health and safety goals." Indeed, some critics have long maintained that health-related studies do not belong in the DOE's domain. "It is...intolerable that the fox could have the exclusive right [or even the primary responsibility] for reporting on morbidity and mortality in the chicken coop," charged Dr. Jack Geiger of Physicians for Social Responsibility in the March 23 issue of *Science*. Among SPEERA's other recommendations are that health and safety work be consolidated within a newly-established DOE office of occupational health and that a policy of greater openness be instituted. The panel called for an additional $15 million in funding and for the DOE to address "many questions about non-nuclear energy-related risks" (see *MWN*, J/F90). A SPEERA spokeswoman told us that EMFs are on the panel's list. Copies of the SPEERA report are available from: DOE, Public Inquiries Branch, PA-5, Washington, DC 20585, (202) 586-5575.

«« »»

After six months, the school board and some parents want to discontinue the yearlong magnetic field measurement program at **Florida's Sandpiper Shores Elementary School**—albeit for different reasons. Following a court order, teachers at the Boca Raton school have been sporting EMDEX meters since November to monitor exposures from high-voltage lines near the school (see *MWN*, N/D89). "We really feel that the program should be terminated," Abbey Hairston, counsel for the Palm Beach County School Board, told us, citing the consistently low readings—averaging under 2 mG—since the program began. "It's costing us a great deal of money," she said. For their part, three parents, who last year sued to close down the school (see *MWN*, J/A89), want the court to suspend the program until the "kinks" are worked out. In April, their lawyer, Larry Marraffino, took their concerns to the court. Marraffino suspects that Florida Power & Light is "redirecting power," which would explain why the "readings have been very low at Sandpiper, lower than those taken two years ago." After all, he explained, since that time, the demand for electricity in the area has increased. Marraffino told us that the parents are willing to compromise: "We would be happy to have the board let concerned parents send their children to the next nearest school"—where there are no nearby power lines.

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Dr. **Granger Morgan** of Carnegie Mellon University is taking heat from all sides over his critical review of **Paul Brodeur's** book, *Currents of Death*, which appeared in the April 1990 issue of ***Scientific American***. On one side, Drs. **Eleanor Adair** and **Robert Adair**, in their own stinging critique, accuse Morgan of repeating some of the same scientific errors as Brodeur. In an as-yet-unpublished letter to *Scientific American*, the Adairs—mimicking Morgan's attack on Brodeur—charge that, "Morgan himself 'oversimplifies and misrep-

Paul Brodeur To Revisit EMF Issue in "The New Yorker"

Paul Brodeur will publish an update to his "Annals of Radiation" in the July 9 issue of *The New Yorker* magazine—on newsstands July 2. In this fourth feature-length installment on the hazards of EMFs, Brodeur will report on clusters of cancer, birth defects and other ailments among people living close to high-current power lines and electrical substations.

Brodeur published a three-part series on the health risks associated with power lines, radar and video display terminals (VDTs) in June 1989 (see *MWN*, M/J89). Last November, an expanded version of the *New Yorker* articles appeared in book form as *Currents of Death*.

resents...the scientific...evidence.' His description is as faulty as Brodeur's, and for the same reasons. And...his misrepresentations are even more harmful to society." The Adairs claim that many "senior scientists" believe that EMF effects are "not credible and that such effects verge on the impossible" and that the "electrophobia fed by Brodeur and Morgan has no better logical foundation than ESP or astrology." Adding to the fire, on June 5, New York City's ***Village Voice*** columnist James Ledbetter accuses both Morgan and *Scientific American* of omitting one key fact from the review: Morgan, who pats EPRI on the head for doing a "remarkably good job" in supporting unbiased high-quality EMF research, received a $300,000 contract from EPRI in 1988.

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BC Hydro *would* do it again. Vice President Chris Boatman told Canadian television that, if the utility had a second chance, it would still offer to buy the homes of people living along its high-voltage power line on Vancouver Island (see *MWN*, M/J89 and J/A89)—in spite of the British Columbia Utilities Commission's opinion that BC Hydro had acted "imprudently." Over at **Ontario Hydro**, Paul Newall told the CBC that he thought BC Hydro had overreacted. Newall said that it is "not an action that Ontario Hydro would contemplate at this point in time." The exchange was featured on the April 16 segment of the CBC's *The Journal*. By the end of May, BC Hydro had purchased 55 properties and planned to buy three more (see *MWN*, S/O89 and N/D89), according to BC Hydro's Peter McMullan. Supporting Boatman's position, McMullan told us, "We made the right decision at the right time."

Prenatal Electric Blanket Use Linked to Childhood Cancer

Children whose mothers used electric blankets during pregnancy had higher risks of brain tumors and leukemia, according to Dr. David Savitz and colleagues at the University of North Carolina, Chapel Hill. This is the first study to link electromagnetic fields (EMFs) from electric blankets to the development of cancer.

In a paper published in the May 1990 issue of the *American Journal of Epidemiology (131*, pp.763-773), Savitz and coworkers Drs. Esther John and Robert Kleckner report that the incidence of brain tumors among the offspring increased by two-and-a-half times—a statistically significant finding. There was a 70% increase in leukemia and a 30% increase for all cancers.

These electric blanket results "are another reason to take the [EMF] issue more seriously," Savitz told *Microwave News* in a telephone interview. Overall, he said, "It's part of the same constellation of evidence pointing in the same direction."

Responding to critics who have argued that some as-yet-undetermined factor was responsible for the increases in childhood cancer observed in past epidemiological studies on power line EMFs, Savitz said that these new results involved "a different exposure with different confounders, so you can't invoke the factor 'X' as has been done with wire codes. The potential source of biases would be different." (For more on this debate, see *MWN*, N/D88 and J/F89.)

The team did not observe any increase in childhood cancer due to prenatal exposures from water beds or from bedside electric clocks.

For those women who used electric blankets during the first trimester of pregnancy, there was a statistically significant 400% increase in brain tumors among their children. But Savitz cautioned that these findings were based on only a small number of cases.

Postnatal electric blanket use by children was also linked to a 50% increased risk of cancer. Here again, the number of cases was small. For acute lymphocytic leukemia, the increase was 90%—a "larger but imprecise association." Neither association was statistically significant.

The team concluded that, "It is noteworthy that the strongest evidence for positive associations was found for electric blankets, given the evidence that these devices are probably the home appliance with the greatest potential for producing elevated time-integrated exposures....electric blankets are associated with levels up to ten times background."

The new case-control study of the parents of 252 children with cancer was based on data collected in the New York Power Lines Project study of childhood cancer and power line EMFs (see *MWN*, N/D86 and J/A87).

Electric Blankets and Testicular Cancer

Electric blanket EMF exposure "contributes little, if at all," to higher risks of testicular cancer among adult white men, according to a paper appearing in the same issue of the *American Journal of Epidemiology* (pp.759-762).

A team of researchers led by Dr. Rene Verreault of the Fred Hutchinson Cancer Research Center in Seattle, WA, found a 40% increased risk of nonseminoma germ cell tumors—the finding was not statistically significant. They did not observe increases in seminoma. They did note that the risk of nonseminoma tumors increased somewhat with increasing duration of electric blanket use.

The team concluded that "chance remains a plausible explanation for the observation."

Call for Prospective Studies

In an editorial accompanying the Savitz and Verreault papers (pp.774-775), Dr. Richard Monson called for prospective epidemiological studies of EMFs that measure "current and future exposures in a precise and unbiased manner" and

"biologic outcome with precision, without error, and in a timely manner."

"I think there are enough scientific questions to warrant studies that collect data prospectively rather than retrospectively," Monson, of Harvard University's School of Public Health in Boston, MA, told *Microwave News*.

With respect to exposures from video display terminals (VDTs), Monson pointed out that, "Such studies are needed to assess the possible adverse effects of work with [VDTs] and pregnancy. It may seem unrealistic to attempt to assess prospectively the association between [VDT] use and specific birth defects, but is there any alternative?" He added that, "Prospective cohort studies that assess the association between occupational exposures to electromagnetic radiation and cancer may require thousands of study participants and decades of follow-up, but is there any alternative? Prospective cohort studies that assess prenatal and childhood exposure to electromagnetic radiation in relation to childhood cancer may indeed be unrealistic. The need in this context is to develop unbiased methods to assess past exposure."

Low Magnetic Field Electric Blankets Hit the U.S. Market

By the end of the year, at least two major U.S. electric blanket manufacturers will introduce low electromagnetic field (EMF) electric blankets.

Casco-Belton Corp. in Grover, NC, which markets its products under the brand name "Soft Heat," claims that its new wiring design reduces exposures from electric blankets to less than 1 mG. Northern Electric Co. in Chicago, IL, reports that the EMF exposures from its low field blankets and mattress pads—sold under the Sunbeam and Slumber Rest brand names—are reduced by 95%.

Citing the Food and Drug Administration's statement last year that there is no evidence that electric blankets are unsafe (see *MWN*, M/A89), Northern Electric President Ray Mehra said that, "The consensus in the scientific community is that there is no scientifically documented illness that is caused by the electric and/or magnetic fields." But he added that his company decided to "respond to what we anticipate may be a growing demand for low EMF appliances."

David Brantley, product manager at Casco-Belton, said that, "We were prompted by the fact that eventually this issue would become important."

Fears of liability rather than consumer pressures may have been responsible for the marketing move, according to one company spokesman. Indeed, Fieldcrest Cannon, the third major U.S. manufacturer, referred all EMF calls to its attorney, who refused to comment on the company's proposed low field bed products.

Brantley said that Casco-Belton's low field blanket will sell for approximately $18.00; the standard model retails for about $16.00. Brantley added that the company anticipates phasing out the standard version over the next 12-18 months. Northern Electric's low field blankets will cost 10% more than their standard models.

More on Sleeping with EMFs

• A prospective epidemiological study of fetal growth retardation and EMFs—from electrically heated beds, among other sources—is now under way at the Yale University School of Medicine in New Haven, CT (see *MWN*, J/A88). The $1.9 million study, which also covers miscarriages, includes direct measurements of EMF levels in the participants' homes. Yale's Dr. Michael Bracken, the principal investigator, told *Microwave News* that he expects results in 1993. The sponsors are the Electric Power Research Institute and the National Institutes of Health.

• Drs. Keith Florig and James Hoburg survey electric blanket magnetic fields in a paper appearing in the April 1990 *Health Physics (58, pp.493-502)*. Florig was, and Hoburg is, at Carnegie Mellon University in Pittsburgh, PA. Using computer models, they estimated that average exposures over the whole body range from 1.5 to 3.3 μT (15 to 33 mG), with a typical value of 2.2 μT (22 mG). In particular, they report that whole-body exposures for children are "significantly greater than those for adults." They point out that all U.S. blanket manufacturers recommend that children not use electric blankets, but they note that this warning is often ignored.

• Australians who use electric blankets may be exposed to significantly lower levels of ELF magnetic fields than electric blanket users in the U.S., according to Dr. Vincent Delpizzo of the Australian Radiation Laboratory in Victoria. He notes that Australians use electric *under*blankets, which operate at 240 V, between the mattress and the bottom sheet. These blankets expose users to average fields of approximately 2 mG, 1.5 mG or 0.5 mG (high, medium and low settings, respectively). U.S. electric blankets, which operate at 120 V and are designed to be used above the top sheet, expose users to average levels of about 5.6 mG. With regard to water beds, Delpizzo notes that they generate higher field levels, 4-5 mG, but only a small proportion of his study group reported using them. See *Radiation Protection in Australia, 7*, pp.67-69, 1989.

• The Electromagnetic Energy Policy Alliance (EEPA) has issued a fact sheet, "Automatic Electric Blankets—Comfort and Value Through Electromagnetic Energy." The four-page pamphlet points out that typical electric blanket magnetic fields are 3-50 mG, considerably below the IRPA ELF guideline of 1,000 mG, and that "the overall body exposure is similar to that generally prevailing throughout the home." It concludes: "...EEPA sees no reason to advise consumers to lose the well-established and valuable benefits which electric blankets provide."

• Some conflicting views on electric blankets were quoted in the *Boston Globe* (December 18, 1989): Dr. Robert Adair, a physicist at Yale University, stated that, "If you followed equal prudence about everything one did in life you'd stay in bed forever, or you'd starve to death because you could eat nothing." Dr. David Carpenter of the New York Department of Health said that he "absolutely" would not buy an electric blanket or let his child use one.

Congressional Moves for More EMF Research

Two new proposals introduced in Congress would provide funds for research on electromagnetic field (EMF) health effects at the Department of Energy (DOE) and the Environmental Protection Agency (EPA).

On May 10, Congressman Frank Pallone (D-NJ) introduced the "Electric and Magnetic Field Research and Public Information Dissemination Act of 1990," H.R.4801. Its key provisions are:

- The DOE would receive $34 million over five years for EMF research. The amount would increase each year, peaking at $10 million in fiscal year (FY) 1995.
- At least $1 million of the new funds would be spent each year on an EMF information center for public education.
- The DOE would investigate alternative electricity distribution systems designed to reduce EMF exposures.
- An advisory committee—made up of representatives of federal and state governments, utilities, public interest groups and academia—would review studies and recommend research priorities. The committee would issue an annual report.
- The DOE would consult with EPA and the National Institute of Environmental Health Sciences (NIEHS) in developing and implementing the EMF program.

Pallone also plans to introduce a separate bill in June that would establish exposure limits along transmission line right-of-ways (see *MWN*, M/A90).

On another front, Congressman George Brown (D-CA) is sponsoring an amendment to EPA's annual authorization bill that would allocate $5 million for EMF research—$1 million in FY91 and $2 million in FY92 and in FY93. Like the Pallone bill, the measure would require EPA to educate the public on EMF issues and work with the DOE and the NIEHS.

The amendment has been approved by the Committee on Science, Space and Technology and must now pass the full House. It must also win approval in the Senate.

DOE and EPRI EMF Reviews

The annual review of research on the bioeffects of ELF electromagnetic fields (EMFs) sponsored by the Department of Energy (DOE) will be held November 4-8 in Denver, CO. The Electric Power Research Institute (EPRI) will hold its annual utility seminar October 16-19 in Austin, TX.

For the first time in many years, EPRI will not be a sponsor of the DOE meeting (see *MWN*, N/D89). The American Public Power Association and the Edison Electric Institute will continue their support, however.

As in the past, the DOE meeting is open to the public and there is no registration fee. For more information, contact: W/L Associates, 120 W. Church St., Frederick, MD 21701, (301) 663-1915.

This year's EPRI seminar is titled "New EMF Epidemiologic Results & Their Implications." Registration fees range from $150.00 for EPRI members, government officials and university researchers to $1,000.00 for others. For more information, contact: Robert Banks Associates, Attn: EPRI Utility Seminar, PO Box 14574, Minneapolis, MN 55414, (612) 623-4646.

EPRI Sponsors $1.6 Million Mouse-Lymphoma Study

The Electric Power Research Institute (EPRI) has awarded Dr. Takashi Makinodan of the University of California, Los Angeles (UCLA), $1.6 million for a five-year study of lymphoma in mice chronically exposed to ELF magnetic fields. A pilot study is already under way.

The objective of the study is to determine whether magnetic fields are carcinogens, cocarcinogens or cancer promoters, Makinodan told *Microwave News*. Makinodan is a professor of medicine at UCLA and a co-director of geriatric research at the Los Angeles VA Medical Center. Ionizing radiation will be used as the initiator. The mice will be exposed to magnetic fields of less than 1 mG, 100 mG or 10 G, either alone or with low or high doses of gamma rays.

Similar efforts to develop an animal model of EMF carcinogenesis are under way in Sweden and in Canada (see *MWN*, M/J87 and J/A89).

Three States Plan Magnetic Field Mitigation Studies

Plans are under way in three states to study ways of reducing electromagnetic fields (EMFs) from high-voltage power lines.

In Washington state, the Department of Health (DOH) is leading a task force charged with investigating EMF mitigation techniques and their feasibility. The task force was mandated by a state law, enacted in March, which appropriated $40,000 for the two-year project; an earlier version of the bill called for a $100,000 budget.

The DOH has been designated by a second law (also passed in March) as the "state radiation control agency," responsible for collecting and disseminating information on non-ionizing radiation, particularly EMFs.

In Florida, the Environmental Regulatory Commission has appointed an independent EMF Task Force to lead a two-year, $1 million survey of magnetic field mitigation methods and costs. The seven-member task force, which began meet-

ing in January, has not yet decided how to spend the money, Jack Buford, the task force chairman, told *Microwave News*.

In April, Ken Klein, formerly of the Department of Energy and now a consultant, was hired as the project manager. Among the members of the task force is Sharon Rausch, one of three Boca Raton, FL, parents who filed suit to close a school near high-voltage power lines (see p.2). The project, which is being funded by the Florida Electric Power Coordinating Group, is an outgrowth of the state's magnetic field rules proceedings last year (see *MWN*, M/A89).

In New York, the Empire State Electric Energy Research Corporation (ESEERCO), a consortium of NY utilities, is soliciting proposals for methods of reducing power line magnetic fields. The successful bidder will characterize significant sources of EMFs and estimate the economic, environmental and social impacts of potential mitigation approaches.

In April 1988, the state Public Service Commission (PSC), following the recommendations of a staff task force, ordered NY utilities to survey power line magnetic fields and investigate ways of minimizing exposures (see *MWN*, M/A88 and M/J88). Utility representatives presented the survey results at a July 26, 1989 technical conference in Albany, NY (see *MWN*, M/A89 and J/A89). In April 1990, the PSC proposed an interim magnetic field standard of 200 mG for new high-voltage line right-of-ways (see *MWN*, M/A90).

The Electric Power Research Institute reported in 1988 that magnetic fields can be reduced by as much as 50% by changing the phasing of the lines (see *MWN*, J/F89).

Two New Low-Cost Meters

Two new inexpensive ELF magnetic field meters are now available. These complement the growing number of gaussmeters and dosimeters that have come on the market in the last two years. (For a complete list, see *MWN*, J/F90.)

Karl Riley of Magnetic Sciences International has developed MAG CHECK, a sensor which, he says, is similar to Electric Field Measurements' Model 116, designed by Dr. Don Deno. The unit, which costs $42.00, plugs into any digital multimeter with a 200 mV AC scale. Riley also offers a combined sensor-multimeter, the MSI-20, for $119.00. Both respond to magnetic fields from 0.1 mG to 200+ G in the 40-400 Hz frequency band. For more information, contact: Magnetic Sciences International, 2425 B Channing Way, Suite 489, Berkeley, CA 94704. Riley can be reached at RFD Box 312, Vineyard Haven, MA 02568, (508) 693-3188.

Widerange Instruments is marketing the MAGALERT model 660. The meter, which costs $84.50, is a small hand-held unit that gives readings from 0.1 to 100 mG. For more information, contact: George Work, Widerange Instruments, 110 Shelter Lagoon, Santa Cruz, CA 95060, (408) 423-1983.

HIGHLIGHTS

U.S. Army Performance on EMP Safety Faulted

An investigation by *Potomac News* into the U.S. Army's record on electromagnetic pulse (EMP) safety has uncovered a long history of ignoring federal environmental regulations and harassing those who pressed for compliance at the Army's Woodbridge Research Facility (WRF) in Virginia.

In a five-part series published in the April 9-13, 1990 *Potomac News*, a Prince William, VA, county newspaper, Gary Craig and Kevin Carmody describe how two Army environmental officials—Dr. Conner Gibson and John Ganz—were allegedly marked as whistle-blowers by the military, thus effectively destroying their careers.

From 1971 to 1988, the Army operated EMP simulators at the WRF, including the Army EMP Simulator Operations (AESOP) and the Repetitive EMP Simulator (REP). During this time, the Army planned to build a more powerful pulser—the Vertical EMP Simulator II (VEMPS II)—similar to the U.S. Navy's EMPRESS II (see box on p.7).

In documents obtained by *Potomac News* and made available to *Microwave News*, Craig and Carmody show how the Army neglected the EMP threat to health and safety and resisted reform:

- Three years after the Navy began work on an environmental impact statement (EIS) for EMPRESS II, the Army sought to avoid preparing a similar analysis for its proposed VEMPS II, because the pulser's operation would be "environmentally insignificant," according to a February 13, 1987 Army memo. This opinion came one month before the Washington, DC-based Foundation on Economic Trends (FET) sued the Department of Defense (DOD) to require environmental assessments for its EMP simulators (see *MWN*, M/A87). As part of a May 1988 agreement to settle the suit, the DOD shut down many of its EMP simulators—including those at Woodbridge (see *MWN*, M/J88).
- The belief that operating the WRF EMP simulators at full power caused no significant environmental impact was "consistent with 'gut' feelings," according to a June 1988 Army memo, which conceded that very little information was available. The Army expressed concern that operating at reduced

power "implies past operations [were] 'dangerous/reckless'." The Army also noted that the question of interference with "fly-by-wire" systems aboard aircraft was unresolved.

• The Army "continually stonewalled the issue of safety in fly-by-wire aircraft operations" (e.g., the Airbus 310 and the Boeing 757 and 767), John Ganz wrote in an April 14, 1989 letter to Senator Carl Levin (D-MI). Ganz claimed that the DOD blocked an FET subpoena because his testimony would be "most damaging" to the Army's case. Ganz said that he and Gibson, his supervisor, were branded as whistle-blowers and were held responsible for the closing down of the EMP programs. A federal investigation into these allegations is under way.

• Following the March 1989 airing of a CBS-TV *60 Minutes* segment on an EMP health effects lawsuit (see *MWN*, J/A88 and N/D88), Ganz lost his supervisory position. When he complained to the Army Inspector General, he was cross-examined about his loyalty to his country and given a polygraph test—which he passed. Gibson was dismissed by the Army in May 1989 and died of a heart attack shortly thereafter.

• Even while the EMP shutdown was in force, the Army sought to run a "free field" EMP test using a suitcase pulser at Fort Belvoir, VA. The proposed test was criticized by an attorney in the Army's Office of the Judge Advocate General in a November 3, 1988 memo: "On a statutory and regulatory basis, it is clear that free field EMP simulation requires an environmental assessment at a minimum. EMP testing is extremely controversial and reliable scientific data has yet to be established."

• The Army's claims to have complied with federal environmental rules were "a total vulgar fabrication," as well as "pathetic" and "totally indefensible," according to Gibson. Commenting on an Army public relations response to a May 10, 1988 *Washington Post* article on the FET's EMP lawsuit (see *MWN*, M/J88), Gibson said that, contrary to the Army's assertions, there were reports dating back to 1973 showing "serious documented concerns" with respect to the Army's compliance with environmental laws. In January 1989, the Army announced that it would prepare an EIS on EMP before resuming testing at Woodbridge. But six months later, the Army decided that it would no longer operate the simulators at Woodbridge and released an environmental assessment which did not address EMP (see *MWN*, J/F89 and J/A89).

• EMP testing at Woodbridge prompted community opposition—the WRF is located near residential neighborhoods and schools. In an August 1, 1989 letter to the Army, County Executive Robert Noe Jr. wrote that, "Prince William County officials have serious concerns over the human health and environmental impacts of the [EMP] testing that was conducted by the Army" and that the "Army has a responsibility to participate on a long-term basis in the evaluation of any human health impacts that may become evident in the future...." Craig reports that the Army is considering doing an epidemiological study of the WRF workers and that the Virginia Council on the Environment has suggested a similar study of Woodbridge residents.

In a response appearing in the May 11, 1990 *Potomac News*, an Army spokeswoman said that, "There were so many errors in fact in the articles that to attempt to correct them would result in another series of articles...."

A copy of the five-part series is available for $5.00 from: Barry Loftus, *Potomac News*, 14010 Smoketown Rd., Woodbridge, VA 22192, (703) 670-8151.

Navy Issues Draft EIS for EMPRESS II in Gulf of Mexico

The U.S. Navy has issued another draft environmental impact statement (DEIS) for its Electromagnetic Pulse Radiation Environment Simulator for Ships (EMPRESS II)—this one for operation in the Gulf of Mexico.

The Navy has evaluated four sites for EMPRESS II in this DEIS, each more than 25 miles offshore. The EMP simulator will be used in the gulf for approximately 60 days a year during the months of November through April (see *MWN*, J/A89). For the other six months, EMPRESS II is used in the Atlantic Ocean off the coast of North Carolina (see *MWN*, J/A88).

The Navy foresees electromagnetic interference to electronics as the only serious impact. To protect marine and aircraft electronics, the Navy will set up an air and surface exclusion zone with a height of 6,000 feet and a two-mile radius. With respect to human health, the Navy "will ensure that personnel aboard the ships under test will receive EMP intensities of no more than 50 kV/m."

This is the fourth EIS or DEIS the Navy has issued for EMPRESS II (see *MWN*, N84, J/F87 and M/J88).

Three public hearings on the DEIS were held in Alabama and Mississippi during the first week of May. For more information, contact: Lt. James Rose, Naval Sea Systems Command (PMS-423), Washington, DC 20362, (202) 746-1386.

USAF Seeks NAS-NRC Study on VLF Bioeffects from GWEN

The U.S. Air Force (USAF) has asked the National Research Council (NRC), an arm of the National Academy of Sciences, to review the potential health effects of very low frequency (VLF) radiation from the USAF's Ground Wave Emergency Network (GWEN). The move came in response to concerns expressed by Congressmen Lewis Payne (D-VA) and Les Aspin (D-WI).

The USAF's proposal is still "under review," Dr. Ray Cooper of the NRC's Board on Radiation Effects Research

told *Microwave News*. The final decision will be made by the Executive Committee of the NRC when it meets on June 13. If accepted, Cooper said that the report would take at least a year to complete.

The USAF's formal request came in a March 6 letter from Lt. Col. Stephen Martin, GWEN's program manager at the Electronic Systems Division at Hanscom Air Force Base, MA. Martin asked the NRC to answer a series of questions on GWEN radiation health risks, especially cancer.

In a telephone interview, Cooper cautioned that, "Some of the questions that the USAF wants answered may not be answerable with the present scientific data."

The GWEN communications system is designed to withstand the electromagnetic pulse (EMP) from a nuclear attack. When completed, it will consist of 96 relay towers across the continental U.S. operating at 150-175 kHz. The peak broadcast power for each GWEN tower is from 2-3 kW; it typically transmits six seconds per hour.

Payne's request for a review followed growing community opposition to plans to build a GWEN tower in his district. According to the *Washington Post* (December 27, 1989), a well-attended town meeting in Lovingston, VA, heard Dr. Stephen Cleary of the Medical College of Virginia in Richmond say that "there is enough information available in the literature [on health effects] to concern people."

For his part, Aspin, the chairman of the House Armed Services Committee, cited the need to update the USAF's final environmental impact statement on GWEN, issued in late 1987 (see *MWN*, N/D87).

Aside from concern over its potential health effects, there is also mounting opposition to GWEN from those who question its cost and utility at a time of reduced risk of nuclear attack. On February 27, Congressman Ron Machtley (R-RI) introduced H.R.4118, which would cut off funding for GWEN. Machtley's bill has gained the support of 13 cosponsors. Senator Claiborne Pell (D-RI) has introduced an identical bill, S.2257, in the Senate.

Nancy Foster, the director of the Amherst, MA-based GWEN Project, which opposes the program, told *Microwave News* that given the "dramatic changes in the world, GWEN should be a prime candidate for any list of Department of Defense budget cuts."

In an effort to defuse concerns about radiation, the USAF set a VLF radiation exposure standard of 50 V/m for publicly accessible areas around GWEN sites (see *MWN*, J/F86). The USAF's standard for its own personnel is 614 V/m.

Vote on Revision of 1982 ANSI RF/MW Safety Standard

Voting is in progress on the final draft of the proposed revision of the American National Standards Institute (ANSI) 1982 safety standard for human exposures to radiofrequency and microwave (RF/MW) radiation. Results of the subcommittee ballot are expected to be announced at a June 9 meeting in San Antonio, TX.

If approved, the proposed standard—designated ANSI C95.1-1990—will go before the IEEE's Committee SCC28 on Non-Ionizing Radiation Hazards for a vote.

In the previous vote, 50 subcommittee members approved the draft, 16 rejected it and 5 abstained. Most of those from federal health agencies voted against the draft. (For more on the proposed revision, see *MWN*, M/A89 and S/O89.)

Przemyslaw A. Czerski (1928-1990)

Dr. Przemyslaw Czerski died of cancer on Sunday, April 15, 1990 in Silver Spring, MD.

Born in Poland, Czerski earned his PhD and MD degrees at the Warsaw Medical Academy. In 1958 he joined the Military Institute of Aviation Medicine. Fifteen years later he became the chairman of the Department of Genetics at the National Research Institute of Mother and Child in Warsaw. In 1981, Czerski came to the United States to work at the Food and Drug Administration's (FDA) Center for Devices and Radiological Health in Rockville, MD.

Czerski's early research was on the hematologic and genetic effects of microwave radiation. He played an important role in setting up one of the first major symposia on microwave bioeffects in Warsaw in 1973. Together with Dr. Stanislaw Baranski, he wrote *Biological Effects of Microwaves* in 1976. At the FDA, he continued his research on the genetic effects of non-ionizing electromagnetic radiation (NIER) at both high and low frequencies. Czerski authored more than 150 publications.

Czerski is perhaps best known for his contributions to the international research community. He encouraged the World Health Organization to initiate NIER programs, first in Copenhagen, then in Geneva. These, in turn, led to the formation in 1977 of the International Non-Ionizing Radiation Committee (INIRC) within the International Radiation Protection Association (IRPA). Czerski was a founding member of INIRC and remained active on the committee until his death. In 1989, the FDA awarded him a commendation for his work.

Czerski is survived by his wife, Ewa, and their two daughters. Dr. Ewa Czerska continues to work at the FDA on NIER biological effects.

Over the years, Czerski made many contributions to *Microwave News*. We will miss him.

The decision on whether to apply EPA's risk assessment guidelines—originally developed for chemical carcinogens—to EMFs will now be made by two independent scientific review groups this summer.

Whatever the outcome, the EMF issue has gone from relative obscurity to national prominence. The question of how to deal with EMFs is now being debated at the highest levels of the Bush Administration and in the halls of Congress.

Regulatory strategies have not yet been formulated, but there is virtually unanimous agreement that a major federal research effort is needed to resolve the uncertainties associated with EMF health risks. It appears almost certain that EPA will resurrect its EMF research effort, which was shut down in 1986 (see *MWN*, S/O85).

A Meeting at the White House

In early 1990, after the OHEA staff made its recommendations and as its report neared completion, briefings were held for senior members of the EPA staff, including Deputy Administrator Henry Habicht II.

On March 6, a group of EPA officials briefed the White House Office of Policy Development. Among those attending the meeting were: Teresa Gorman, associate director of policy development for environment, energy and natural resources; Dr. James Wyngaarden, associate director for life sciences at the White House Office of Science and Technology Policy (OSTP); Richard Guimond, director of EPA's Office of Radiation Programs (ORP); and OHEA's Farland. Also present were representatives of EPA Administrator William Reilly, the Department of Energy (DOE), the Centers for Disease Control (CDC) and the National Cancer Institute (NCI).

Several sources characterized the meeting as an "information exchange." A staffer in Reilly's office told *Microwave News* that "it's not unusual" for EPA to advise the White House in memos or briefings about a significant issue. Gorman was unavailable for comment.

At a congressional hearing on power line health risks held by Rep. Peter Kostmayer (D-PA) just two days after the White House meeting, representatives from the DOE and EPA did not reveal that a major policy change was under discussion (see *MWN*, M/A90).

As late as March 12, the EPA evaluation recommended classifying ELF EMFs as "Class B1—probable human carcinogens." Within a week, the designation was deleted.

EMFs Pass the "Duck Test"

EPA insiders told *Microwave News* that the deletion of the B1 designation† for ELF EMFs was a compromise between the staff's recommendation and Farland's proposal to classify EMFs as "Class C—possible human carcinogens."

In a telephone interview, Farland explained that he personally deleted the B1 designation because "it was not appropriate at this time to classify EMFs as a carcinogen as we have classified other chemicals."

Farland said that he will ask two committees of experts—an external review panel and EPA's Scientific Advisory Board (SAB)—each to decide how to resolve the issue of risk classification.

Asked whether a chemical agent with the same carcinogenicity data as ELF EMFs would have been classified as B1, Farland replied: "I would still have some concerns classifying it as a probable human carcinogen if I really did not understand how it was working."

"The kind of information we have is enough for me to say that there is something going on and that the epidemiological data should not be dismissed," he said. "On the other hand, there is not enough to cause undue alarm. We need additional research."

Rep. Kostmayer urged EPA not to shy away from a cancer risk designation. In an April 25 letter to Reilly, Kostmayer wrote, "There can be no doubt that power line EMFs have passed the 'duck test': If it acts like a potential carcinogen, it must be addressed as a potential carcinogen." He stressed that, "The technical reasons given by EPA for not formally classifying power line EMFs as a 'potential carcinogen' may have merit, but for the purpose of protecting American citizens the distinction is moot."

Potential Carcinogens: EPA "Weight-of-Evidence" Classification and Hazard Ranking

Class A: Human Carcinogen	*Class B: Probable Human Carcinogen*		*Class C: Possible Human Carcinogen*
	B1: Limited Epidemiologic Evidence	*B2: Sufficient Animal Evidence*	
Arsenic (H)	Acrylonitrile (M)	Beryllium (M)	Methyl Chloride (L)
Asbestos (H)	Cadmium (M)	Carbon tetrachloride (M)	Saccharin (L)
Benzene (M)	Creosote (H)	DDT (M)	Trichloroethane (L)
Diethylstilbestrol (H)	Ethylene oxide (M)	PCBs (M)	
Vinyl chloride (H)	Formaldehyde (M)	Dioxin (H)	

Hazard Ranking: (H)=High; (M)=Medium; (L)=Low. Source: Office of Health and Environmental Assessment, EPA, June 1988.

The management of EMF risks will fall on EPA's ORP. Marty Halper, ORP's division director with responsibility for non-ionizing electromagnetic radiation (NIER), told *Microwave News* that EPA would not respond any differently whether the designation were A, B1 or C. Referring to siting battles over new power lines and radars across the U.S., he said, "The public is already extensively regulating EMFs: the net cost to society of EPA regulations may be less than what we are paying now."

Indeed, speaking at a conference in Cleveland, OH, at the end of April, ORP's Dr. Doreen Hill said that EPA is "swamped" with requests for EMF information from the public (see p.2).

"You can no longer say there are no biological effects due to ELF EMFs," Halper said. "But I can't say what the public health implications are. We're not talking about a radon in terms of potency, but we're also not talking about a zero effect."

RF/MW Radiation: A "Possible" Carcinogen

The OHEA report grew out of EPA's plan to issue rules for human exposures to RF/MW radiation (see *MWN*, J/A86). In 1986, EPA decided there was a need for an independent evaluation of the results of the long-term exposure study led by Dr. Bill Guy of the University of Washington, Seattle, which indicated an increase in cancer among rats chronically exposed to non-thermal doses of RF/MW radiation (see *MWN*, J/A84 and Mr85).

In the March 12 version of the OHEA report, the EPA staff recommended that RF/MW radiation be designated as a Class C carcinogen:

> For modulated non-thermal RF radiation, the human evidence is inadequate and the animal evidence is 'limited' based on the finding of a field-induced increase in the incidence of carcinomas of all sites in rats in an experiment that produced minimal tissue heating. Therefore, the evidence of carcinogenicity for non-thermal modulated RF radiation dictates a classification as a 'possible,' or Class C, carcinogen. In this case it is not called a carcinogen risk factor since the radiation treatment alone induced the effects without an additional factor in the experiment protocol.

This conclusion was also deleted from the review draft.

In an interview, ORP's Halper said that, "I am not ready to say we don't have concern outside the ELF area. We don't have the data." He emphasized that the document addresses all NIER. "We're being very careful to talk about NIER, not just ELF," he said.

* In 1986, EPA issued guidelines to assist in ranking suspected carcinogens in a consistent manner. There are five categories: "Human Carcinogens" (Group A), "Probable Human Carcinogens" (B), "Possible Human Carcinogens" (C), "Not Classifiable as to Human Carcinogenicity" (D) and "Evidence of Non-Carcinogenicity for Humans" (E).

† Chemicals which have been rated as probable human carcinogens on the basis of animal bioassays are designated as Subgroup B2. When the classification is based on human epidemiological studies—as in the case of ELF EMFs—a B1 designation is used.

EPRI CEO Goes to Washington To Talk EMFs

Dr. Richard Balzhiser, the president and chief executive officer (CEO) of the Electric Power Research Institute (EPRI), was in Washington at the end of May to talk to senior governmental officials about electromagnetic fields (EMFs).

On May 23, Balzhiser met with Dr. James Wyngaarden, associate director for life sciences at the White House Office of Science and Technology Policy (OSTP). Two days later, Balzhiser, accompanied by EPRI Vice President Dr. George Hidy, the director of the institute's environment division, met with EPA Administrator William Reilly and his staff. While in Washington, Balzhiser also spoke to officials at the National Academy of Sciences.

"Balzhiser wants to encourage as many agencies as possible to initiate work on EMFs on their own in order to have a broad scientific research program," EPRI's Barbara Klein told *Microwave News*. "We don't want to be the only players." Klein noted that Balzhiser and Hidy also had other energy-related issues on their agendas.

Dr. Robert McGaughy, project manager for the OHEA report, told *Microwave News* that the document "only addresses cancer and not central nervous system or reproductive effects."

Review Schedule

In an unprecedented move, Farland has decided to release a draft of the document to the public in June, before it is reviewed by EMF experts outside of the agency. "There is enough interest in the document to warrant its early release," he said. As a result, many federal agencies with responsibilities for EMFs will first see the document at the same time as the public.

In late May, EPA sent letters to potential reviewers seeking their participation: McGaughy said that he plans to assemble six to eight experts. This external review panel is scheduled to meet in Research Triangle Park, NC, at the end of June to discuss the draft document.

Following the March 6 White House meeting, the representatives from the DOE, NCI and CDC requested and received copies of the OHEA draft report. Each has already submitted comments to EPA. Informed sources told *Microwave News* that the NCI was critical of the EPA effort. The White House did not submit comments.

Sources said that the DOE distributed dozens of copies of the OHEA review to its staff and to its contractors.

After the external review is completed and the document is revised, it will go to the SAB Radiation Advisory Committee. Originally, EPA planned to make the draft public at that

time.

Whether the external review panel or the SAB will reinstate the B1 classification is not known. But the SAB is already firmly on record as favoring an EPA research program on EMFs.

In a May 4 letter to Administrator Reilly, Drs. Oddvar Nygaard and Raymond Loehr, the chairmen, respectively, of the SAB Radiation Advisory Committee and the SAB Executive Committee, argued that EPA should take an aggressive role in EMF policy. "The [SAB] continues to urge the agency to undertake a leadership role in this complex and important area," they wrote. "There is enough substance to the science in this area to require your attention." In 1988, the SAB wrote to then EPA Administrator Lee Thomas advising that the agency take an active role in NIER bioeffects research (see *MWN*, S/O88).

Specific plans for EMF research remain unclear. Farland told *Microwave News* that, "At this point there is an initiative in the several-million-dollar range," adding that most of the work would be done outside EPA. But other EPA officials said that no more than $2 million will be allocated for EMFs and new research may not begin until October 1991— that is, the 1992 fiscal year. They added that there continues to be resistance within EPA to resuming an in-house research effort.

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FROM THE FIELD

Summary and Conclusions of EPA's EMF Cancer Report

Reprinted below are the "Summary and Conclusions" of the Environmental Protection Agency's (EPA) draft report, An Evaluation of the Potential Carcinogenicity of Electromagnetic Fields (EMFs). *This summary, dated June 1990, will accompany the draft of the report which will be distributed to the external review panel, assembled by EPA.*

7.1. Introduction

In this chapter each of the major chapters in the document are summarized; a final section presents a discussion of the relationships among the individual chapters and the overall conclusions.

7.2. Mechanisms of Interaction Between Tissue and EMFs

The basic processes by which energy from EMFs of RF and ELF frequencies is coupled to the body are described in this section. The frequency dependence of the RF power absorbed by an organism is dominated by the body size, so that mice, rats and humans have different RF absorption characteristics. For ELF fields and the lower RF frequencies near the source, the relationship between the electric and magnetic fields is not fixed, as it is for RF fields, and they are evaluated separately in this document. From the point of view of EMFs, the body is composed of a solution of ions; it is an electrical conductor and the penetration of electric fields into the body is very poor at ELF frequencies. Since the body is composed of nonmagnetic materials, an external time-varying magnetic field permeates the body, inducing ionic currents.

The human evidence, as described in the next section, suggests that magnetic fields rather than electric fields are associated with cancer incidence, and mechanisms have been sought to explain how weak currents induced by ELF magnetic fields could interact with cells and body tissue in such a way as to induce a carcinogenic response. Three classes of models for this interaction are reviewed: (1) The surface compartment model deals with the movement of ions towards and away from the inner and outer surfaces of the plasma membrane of the cell, and deals with ion-selective membrane channels, ionic pumps and membrane ion fluxes. The model describes the movement of ions in response to perturbations of electric fields and magnetically induced currents around the cell. (2) The ion cyclotron resonance hypothesis was developed in part to explain the frequency sensitivity of calcium ion efflux studies of brain tissues. If the relationship among the frequency of time-varying magnetic field, the strength of a parallel static magnetic field and the ionic charge to mass ratio of an ionic species is correct, then the ion will resonate, or synchronously follow circular paths in a plane perpendicular to the field. In one experiment demonstrating this effect, conditions were set up for calcium cyclotron resonance, and the movement of bethnic diatoms was measured. The experiment showed that calcium ions entered into the cell under these specific conditions and stimulated the motion of the cells, whereas the cell is normally impermeable to calcium. This type of mechanism could be the basis of an induced selective ion permeability of the plasma membrane and might ultimately be capable of explaining both frequency selectivity of these effects and the sensitivity to small induced currents. (3) Another class of models deals with cooperative motions of an ordered array of lipid bilayer molecules and describes how a weak field affecting the motion of the whole array could be transferred to just one site in the array. These theories have not yet been tested in the context of ELF biological processes. At the present time, these basic models of tissue interaction with EMFs cannot be linked to the biochemical or cellular processes involved in the development of malignant growth.

7.3. Human Evidence

The effects of human exposure to EMFs from several sources have been reported. This document discusses ELF fields separately from higher frequency exposure where possible. Children with residential exposure are more appropriate subjects than adults for evaluating the effects of ELF fields, since children have relatively little exposure to higher frequency fields and occupational chemicals as a consequence of their normal activity patterns. Consequently, studies of childhood cancer associated with residential exposure to 60 Hz power frequency fields are discussed separately from occupational exposure to adults, which involves a mixture of both ELF and RF

fields.

7.3.1. ***Studies of Children:*** There have been six case-control studies of cancer in children examining residential exposure from power transmission and distribution systems and two additional studies examining childhood cancer in relationship to fathers' occupations. Five of the six residential exposure studies showed positive associations with ELF field exposure; three were statistically significant and the other two had odds ratios greater than one but not statistically significant. Where different cancer sites were evaluated, leukemia, nervous system cancer and, to a lesser extent, lymphoma were found to be in excess in the five residential studies showing positive associations. (Electric fields are not believed to be a critical factor.) The measure of magnetic field exposure was variable in the six studies. Wire code configurations and proximity to distribution lines were used for five of the six studies, and measurements were taken in two of the six studies. There is a good, but not perfect, correlation between measured magnetic fields and wire code configurations. In two of the studies in which magnetic field measurements were made, cases were observed in those exposed above 2-3 mG (0.2-0.3 μT) but not in people exposed below that level. Although one study found a significant dose-response relationship with respect to surrogate measures of exposure, reliable dose-response information is not available due to the use of dichotomized exposure categories and due to small numbers of cases within the exposure groupings. Issues pertaining to personal exposure and latency have not been addressed. The two paternal occupational studies found statistically significant associations between neuroblastoma and brain cancer, respectively, in children and their fathers' exposure to EMFs. There was also one report of a cluster of a rare tumor type (endodermal sinus tumors) in adolescent girls exposed to EMFs from power distribution lines....

The consistently repeated pattern of leukemia, nervous system cancer and lymphoma in the childhood studies and the ruling out of several confounding exposure factors in the Savitz et al. (1988) study argue in favor of a causal link between these tumor types in children and exposure to ELF magnetic or electric fields. However, the fact that the odds ratios are small and in many cases not statistically significant indicates that the association may not be strong and therefore argues against a causal relationship.

7.3.2. ***Studies of Adults***

7.3.2.1. *Residential Exposure to Power Frequency Fields:* In a total of four reports of cancer mortality or incidence in adults residing near electrical power distribution equipment, three were nonpositive and the fourth was clearly positive. In a case-control study of adult leukemia in Los Angeles, there was no association with electric blanket usage in the home. In contrast to childhood cancer, the adult studies were more difficult to interpret because they lacked the statistical power to detect a relative risk of the magnitude typically observed in the childhood studies and because there was little evidence that the cases were exposed to levels of EMFs higher than fields to which the controls were exposed. Therefore, no conclusions can be made about a cancer response and adult exposure to residential fields.

7.3.2.2. *Occupational Exposure to ELF and Mixed Frequency Fields:* Over 30 reports dealing with cancer incidence or mortality in workers in electrical and electronic occupations have been reviewed. These exposures have involved 50 or 60 Hz power frequency fields as well as mixtures of higher frequency fields which are typically poorly defined. The studies have been carried out in Europe, New Zealand and the United States. Many of them were re-examinations of previous studies or evaluations of vital records, cancer registry or occupational data bases, and thus the populations were not formed to test the specific hypothesis of whether EMF exposure is associated with increased cancer risk. Most of them used death certificates as a source of occupational information; this information furnishes only a very crude indicator of actual exposure to EMFs. Many of these are proportional mortality studies, which are less informative than studies of cohort and case-control designs because their results are affected by extraneous causes of death.

In these studies three types of cancer predominate: (1) hematopoietic system, especially leukemia and specifically acute myeloid leukemia; (2) nervous system cancer, including brain tumors; and (3) malignant melanoma of the skin. These cancer sites are found consistently across different geographic regions, age groups, industries, occupational classifications and study designs. Given this diversity of studies, in addition to the likelihood that across broad job categories the exposures to various chemicals is not uniform, it is difficult to identify any single agent or group of confounding exposures that could explain the consistent finding of these same cancer sites.

7.3.2.3. *RF Exposure:* Reports that focused primarily on exposures to RF radiation have shown mixed results, but most of the studies were difficult to interpret. Two early reports concerning microwave [MW] exposure of the U.S. embassy personnel in Moscow and radar exposure of U.S. Navy personnel showed only a slight tendency for increased cancer risk at all sites, and somewhat higher odds ratios for hematopoietic system cancers. A study of personnel in a World War II radar research and development laboratory found no convincing evidence of increased cancer incidence, but errors of exposure misclassification are likely. A series of reports of ham radio operators found a statistically elevated incidence of acute myeloid leukemia and other neoplasms of the lymphoid system, but no clear dose-response trend was seen with longer exposure, where the degree of exposure was inferred by FCC operator license class. One report of military exposure to radar found increasing rates of hematopoietic cancer of specific sites, but a lack of detail limits the ability to interpret the results.

7.3.3. ***Summary of Human Evidence:*** The strongest evidence that there is a causal relationship between certain forms of cancer, namely leukemia, cancer of the nervous system and, to a lesser extent, lymphoma, and exposure to magnetic fields comes from the childhood cancer studies. Several studies have consistently found modestly elevated risks (some statistically significant) of these three site-specific cancers in children. In two of the studies in which magnetic field measurements were made, cases were observed in those exposed above 2-3 mG (0.2-0.3 μT) but not in people exposed below that level. This is supported by the fact that children have relatively few confounding influences that could explain the association. In fact, the few potential confounders and biases that might have had an effect on the results were examined by one of the authors in some detail and found not to be a serious problem. No other agents have been identified to explain this association. However, there are contradictory results within these same studies, and dose-response relationships could not be substantiated. Furthermore, there is little information on personal exposure and length of residency in the EMFs.

Additional, but weaker evidence that there is an elevated risk of leukemia, cancer of the nervous system and perhaps other sites comes from occupational studies of EMF exposure. Although many of these studies have found an excess risk of these forms of cancer with employment in certain jobs that have a high potential for exposure to EMFs, few or no measurements have actually been taken in those occupations. Furthermore, information about occupation has come generally from sources that could be characterized as sketchy. The likelihood that misclassification or information bias is present in these studies is high. However, exposure misclassification, if random, tends to bias relative risks toward the null. Despite these weaknesses, the occupational studies tend to support the results of the

childhood studies, since the excess relative risks occur at the same sites.

The studies of residential adult exposures to EMFs provide little evidence of a risk of leukemia, mainly due to lack of statistical power and/or probably little exposure to levels of EMFs which have been found to be associated with cancer in children. These studies cannot be interpreted as evidence either for or against a causal association between cancer and EMF exposures. On the other hand, the case-control study of cancer in Colorado residents does support an association of central nervous system cancer and lymphoma if proximity to high-current electrical wiring configurations is assumed to be an adequate surrogate for exposure.

The studies of adults exposed to RF radiation produced mixed results, primarily because of limited sample size, inadequate length of follow-up, imprecise exposure data and lack of information on potential confounders. These problems prevent conclusions to be made about causal relationships with RF exposures. However, the statistically significant excess risks of leukemia in amateur radio operators require further examination.

7.4. Animal Carcinogenicity Evidence

7.4.1. ***ELF Fields:*** No lifetime animal carcinogen bioassay studies of ELF fields have been reported in the literature. Two studies currently in progress are designed to observe the induction of a carcinogenic response to chronic magnetic field exposures.

7.4.2. ***RF Radiation:*** Two chronic studies in mice have used unmodulated RF radiation at 800 MHz and 2450 MHz, respectively. Two studies in rats have used pulse modulated 2450 MHz of low power density and pulsed RF of all frequencies from 0 to about 20 MHz of high power density, respectively. One mouse study used pulsed RF radiation of 9270 MHz.

7.4.2.1. *Unmodulated RF Radiation:* For unmodulated RF radiation, one of the mouse studies (Szmigielski et al., 1982) shows that the radiation enhances the growth rate of spontaneous mammary tumors and in a separate experiment enhances the growth rate of skin tumors initiated by a chemical carcinogen, benzo(a)pyrene. In a shorter test (3 months), the same authors showed that the radiation also enhances the growth rate of transplanted lung carcinoma cells, an effect attributed to the lowering of cell-mediated immunity. Unfortunately, histopathology was not reported in the other mouse study (Spalding et al., 1971), so conclusions about carcinogenicity from that study are difficult to make.

The special nature of the response indicates that unmodulated RF radiation might be a promoter or cocarcinogen, since the growth rate of spontaneous breast tumors, BaP-induced skin tumors and transplanted lung sarcoma cells is enhanced by the radiation. There is a remote possibility that body heating could have contributed to this response, since the absorbed RF power is estimated to be at least one-half of the basal metabolic rate of the animals.

7.4.2.2. *Modulated RF Radiation:* For modulated RF radiation of relatively low power density [i.e., excluding the high power electromagnetic pulse (EMP) experiment of Baum et al. (1976)], the mouse experiment (Prausnitz and Susskind, 1962) showed a reversible pattern of lymphoma and leukemia which, in serial sacrifices, occurred toward the end of the 14-month exposure period but was not present in animals after a 5-month recovery period. However, the short 4.5-minute daily exposure was intense enough to raise the body core temperature by 3°C, raising the possibility that thermal effects were a contributing factor in the response. The rat study (Guy et al., 1985) showed the induction of benign adrenal medulla pheochromocytomas and a statistically significant increase in carcinomas of all organ and tissue sites. There was also a higher incidence of glandular organ carcinomas which was unaccompanied by an increase in the incidence of benign tumors of these sites. Although an increase of tumors of all types in the aggregate is regarded as only minimal evidence of carcinogenic action by chemical agents, the fact that the RF radiation affects all tissues in the body independently of their individual biochemical characteristics constitutes a reason to consider the aggregate count a relevant finding.

7.5. Supporting Evidence of Carcinogenicity

Section 5.11. presents a summary of the effects of EMFs on a variety of basic biological phenomena relevant in some way to mechanisms of carcinogenesis; that information is not repeated here. ELF fields of relatively high intensity (producing induced body currents on the order of 10 $\mu A/cm^2$) have enhanced DNA synthesis, altered the transcription of DNA into mRNA, altered the molecular weight distribution during protein synthesis, delayed the mitotic cell cycle, induced chromosome aberrations, blocked the action of parathyroid hormone at the site of its plasma membrane receptor, induced enzymes normally active during cell proliferation, inhibited differentiation and stimulated the growth of carcinoma cell lines, inhibited the cytotoxicity of T-lymphocytes (which indicates an impairment of the immune system) in vitro but not in vivo, inhibited the synthesis of melatonin (a hormone that suppresses the growth of several types of tumors), disrupted the morphology of neurons and glial cells in the central nervous system and caused alterations in the binding of calcium to brain tissues. The large variety of exposure conditions and the lack of detail on the geometry of the biological samples in these studies preclude a systematic evaluation of the actual induced currents and field strengths at the tissue and cellular level that are causing these effects. In addition, the lack of reproducible results between laboratories limits the interpretation of much of this literature.

RF fields modulated at the same ELF frequencies that cause some of the effects noted above also result in the same responses, indicating that the ELF component may be responsible for these effects. Unmodulated RF radiation has not caused any of the effects noted above except for chromosome aberrations. None of the EMFs have caused gene mutations, sister chromatid exchanges or DNA damage (as measured by DNA breaks, DNA repair or differential killing of repair defective organisms) in a large number of studies.

Only three ELF effects have been induced at field strengths comparable to the low environmental exposures at which human cancer has putatively been caused: (1) the calcium efflux from brain tissue preparations using 16 Hz crossed electric and magnetic fields; (2) calcium efflux from chick brain tissue after exposure of the developing embryo to electric fields; and (3) the inhibition of melatonin synthesis by the pineal gland when a static magnetic field of approximately the strength of the earth's magnetic field is changed through a small angle of rotation. The results of the first experiment are one of several phenomena that show a complex dependence on frequency, intensity and orientation with respect to the earth's magnetic fields.

In view of these laboratory studies, there is reason to believe that the findings of carcinogenicity in humans are biologically plausible. However, the explanation of which of the biological processes is involved and the way in which these processes causally relate to each other and to the induction of malignant tumors is not understood. Most of the effects have been observed at field strengths that are many times higher than the ambient fields which are the putative cause of the childhood cancers in residential situations; as a consequence, many of the candidate mechanisms may not be really involved in the response to low environmental fields. The same issue of low-dose extrapolation arises in the evaluation of chemical agents.

7.6. Integrated Discussion of Separate Chapters

The occurrence of cancer in humans exposed to low frequency

EMFs has been observed under several different conditions in different populations. Residential exposure of children, but not adults, has been associated with leukemia, lymphoma and brain cancer, and the same sites occur in multiple studies of children. The fields involved in these associations are magnetic and not electric fields, made up of primarily 60 Hz components but with inevitable high frequency components introduced by electric motors and the switching of currents on and off. In a few studies, these effects have been observed in children exposed to average magnetic fields above 2-3 mG (0.2-0.3 μT) but have not been seen in children exposed to smaller fields. The types of EMF exposures in the occupational studies are variable according to job category, with some jobs involving pulsed and modulated RF fields as well as 60 Hz power frequency components.

There is some, but not well-established, evidence that higher frequency components have different effects than 60 Hz components. Electrical switchyard workers exposed to spark discharges just before blood samples are taken have chromosome aberrations, whereas similar workers with no such exposure do not. Chromosome aberrations have been induced by unmodulated RF fields as well as by ELF fields. A recent preliminary report of an epidemiologic study of telephone workers shows a different effect (rare breast tumors in males) in people working in the "central office," where switching equipment is typically concentrated, than in cable splicers (leukemia) who presumably are exposed to predominantly 60 Hz power frequencies. Both electric and magnetic fields are more effective in inducing currents in the body if their frequency is higher, so that if induced currents are responsible for these effects, then the higher frequency components are expected to be more effective. If it is true that, as two studies indicate, the fathers' occupations in electrical jobs is a factor in the development of leukemia in their children, then the question is raised whether the effect could be transmitted via heritable genetic damage in sperm. This speculative hypothesis needs to be investigated.

Although there are several candidate EMF-induced biological phenomena...that could explain how a cancer response is caused in the whole organism by these fields, none of these or any combination of them has been verified experimentally, either in laboratory animals or in humans. Without understanding which combination of these is relevant to the carcinogenic process, it is not possible to hypothesize what aspect of EMF exposure is responsible for biological effects: i.e., frequency, average peak field strength, duration, time of day, whole-body average versus local critical site, electric versus magnetic fields, orientation with respect to the earth's static magnetic field. The choice of which aspect of the fields is the most relevant could be based on either knowledge of the correct mechanism of action or on empirical epidemiology correlations, but, given the current lack of information, neither method can serve as a basis for a dose-response analysis.

There are several indications that EMFs might contribute to the induction of cancer via indirect mechanisms, in contrast to a direct mutagenic action of DNA as is the case with nitrosamines, polycyclic aromatic hydrocarbons or other DNA-alkylating agents.

First, EMFs have not caused gene mutations in any of the large number of experiments carried out with both ELF and RF fields.

Second, there is no indication from the animal studies that RF fields cause a de-novo induction of tumors. On the contrary, the mice experiments by Szmigielski et al. (1982) indicate that unmodulated RF radiation acts as a growth stimulator for preexisting tumors. The same growth-stimulating or promotion characteristics of RF fields could explain the induction of glandular tumors in the Guy et al. (1985) lifetime rat study of modulated RF radiation, since many of the glandular tumors in that study had a naturally high spontaneous incidence.

A third factor indicating that there may be multiple causes of carcinogenic action is that 120 Hz-modulated 2450 MHz radiation can act as an initiator of phorbol ester-promoted cell transformation in mouse embryo cell cultures.

Finally, there are possible cancer induction mechanisms mediated by the central nervous system causing neuroendocrine influence on cellular proliferation. These mechanisms involve possible extremely sensitive detection of magnetic fields by the retina with resulting neural control of pineal melatonin activity, which in turn modulates estrogen and prolactin levels in the blood supply to the breast, prostate and other hormonally-sensitive tissues. Other speculative chains of events could be fabricated from the existing information in this document, and this one is mentioned here only as an example that there are many possible explanations but no verified ones.

In view of this, it is likely that if EMFs do contribute to the induction of cancer, the causal relationship will probably turn out to be dependent on many chemical factors and physiological conditions that are currently poorly understood.

There are two issues in the hazard evaluation of chemical carcinogens that are analogous to issues for EMFs. It may be helpful to explore whether the assumptions and conventions developed for chemicals are applicable to the EMF problem.

One analogy is that EMFs are mixtures consisting of several frequencies, intensities and combinations of electric and magnetic fields, which (for ELF frequencies) occur in arbitrary proportions. One approach to the assessment of chemical mixtures is to identify hazardous components of the mixture and, assuming additivity of components, consider the risk of the mixture to be proportional to the risk of the hazardous components. If this concept were applied to the EMF problem, then magnetic fields from 60 Hz power usage in the home would be the only "hazardous component" identified, although there is some indication that occupational exposures of adults to mixed fields may cause the same effect. Laboratory studies under relatively controlled conditions of exposure have not been able to test the additivity assumption for EMF components or for chemical components except for a few rare cases, but one feels more comfortable with the latter. With chemical agents, the basic phenomenon is ultimately some chemical reaction, which is expected to have additive properties at low enough concentrations, or at least to be monotonic in the sense that more chemical produces a greater effect. With EMFs, however, the ultimate causative interaction between fields and biological systems is unknown, and there is certainly no additivity with RF and ELF fields, or with ELF electric and ELF magnetic fields. The consequence of not being able to add the risks for different exposures is that the effects for each combination must be investigated and assessed separately.

Another analogy is the similarity between the "biologically effective dose" for chemical agents and the critical electrical measure of tissue "dose" which causes the effect for EMFs. For chemical agents the relationship between "administered dose" and "effective dose" has been studied occasionally, but only rarely. In the absence of this information, the default position for chemical agents has been to assume a linear relationship. Then there are hosts of unresolved questions in determining whether the biological effect is proportional to the "effective dose." These questions arise when, as is usually the case, the mechanism of action is not known. Here again the linearity assumption is made in the absence of knowledge, and the overall default position is that the adverse effect is proportional to the administered dose of the chemical agent. For EMFs, the "tissue doses" could be calculated, typically with great difficulty and uncertainty, but the same type of questions needs to be answered about which of these dose metrics are relevant for EMF exposure. As with

chemical agents, the choice of a candidate mechanism of action dictates which tissue dose metric is appropriate, and there could be several mechanisms for each of the administered agents. For EMFs, the default linearity assumption is not appropriate basically because there are frequency and intensity "windows" of activity for more than one EMF-induced biological effect and such "window" interactions cannot be ruled out as contributory to cancer causation.

In conclusion, the several studies showing leukemia, lymphoma and cancer of the nervous system in children exposed to magnetic fields from residential 60 Hz electrical power distribution systems, supported by similar findings in adults in several occupational studies also involving electrical power frequency exposures, show a consistent pattern of response that suggests, but does not prove, a causal link. Frequency components higher than 60 Hz cannot be ruled out as contributing factors. Evidence from a large number of biological test systems shows that these fields induce biological effects that are consistent with several possible mechanisms of carcinogenesis. However, none of these processes has been experimentally linked to the induction of tumors, either in animals or humans, by EMFs. The particular aspects of exposure to the EMFs that cause these events are not known.

In evaluating the potential for carcinogenicity of chemical agents, EPA has developed an approach that attempts to integrate all of the available information into a summary classification of the overall weight-of-evidence that the agent is carcinogenic in humans. At this time such a characterization regarding the link between cancer and exposure to EMFs is not appropriate because the basic nature of the interaction between EMFs and biological processes leading to cancer is not understood. For example, a real possibility exists that exposure to higher field strengths is actually less hazardous than exposure to low field strengths. Because of this uncertainty, it is inappropriate to make generalizations about the carcinogenicity of EMFs. As additional studies with more definitive exposure assessment become completed, a better understanding of the nature of the hazard will be gained. With our current understanding we can identify 60 Hz magnetic fields from power lines and perhaps other sources in the home as a possible, but not proven, cause of cancer in people. The absence of key information summarized above makes it difficult to make quantitative estimates of risk. Such quantitative estimates are necessary before judgments about the degree of safety or hazard of a given exposure can be made. This situation indicates the need to continue to evaluate the information from ongoing studies and to further evaluate the mechanisms of carcinogenic action and the characteristics of exposure that lead to these effects.

UPDATES

LITIGATION

FM Radio-Cancer Suit Settled...KYGO, an FM radio station near Denver, CO, has settled a lawsuit alleging radiation-induced cancer for an undisclosed sum. The suit, filed in August 1988 against station owner Jefferson-Pilot Broadcasting, Inc., charged that RF radiation had caused Beryl Main to develop non-Hodgkin's lymphoma and had exposed his wife to an increased risk of cancer (see *MWN*, S/O89). The agreement was reached in late March just as the case was about to go to trial. "I'm not permitted to disclose the terms of the settlement," Bruce DeBoskey, the Mains' attorney, told *Microwave News*. "I am totally unable to describe them." DeBoskey, of Silver & DeBoskey, is based in Denver. A 1986 survey by the EPA identified RF levels as high as 300 $\mu W/cm^2$ on the patio/deck of the square dance camp Beryl Main owned and operated with his wife near the KYGO broadcast tower—a hotspot of 10.35 mW/cm^2 was measured at the base of the tower (see *MWN*, M/A87). After the data were released, KYGO lowered its power output from 100 kW to 1 kW and agreed to limit radiation levels on camp property to 10 $\mu W/cm^2$ (see *MWN*, M/J87). The station later moved its antenna and transmitter.

OVENS

Salty to the Core... Salty foods cooked in a microwave oven may not heat evenly, two microbiologists at the U.K.'s Leeds University have concluded after doing a simple experiment with mashed potatoes. In a letter to *Nature* (April 5, 1990), Drs. Stephen Dealler and Richard Lacey describe how the higher the salt (or any other ionic compound) concentration in mashed potatoes, the lower their core temperatures after microwave cooking. They suggest that their finding may explain the recent increases in salmonellosis in the U.K., which is associated with eating incompletely cooked foods. Prepackaged microwave foods—which often have high sodium concentrations—might also be affected, they note. They suggest that the poor penetration of microwaves in saltier foods might be due to "the induction of electrical/ionic flow in the surface of food," and that this would also explain why "commercial food heated in microwaves commonly boils on the surface but is cool on the inside." (For more on incomplete cooking, see *MWN*, Ju81, A82, S/O88 and M/A89.)

PEOPLE

Dr. **Carl Durney** of the University of Utah, Salt Lake City, has been elected to membership in the National Council on Radiation Protection and Measurements (NCRP)....Dr. **Andrew Marino**, the editor of the *Journal of Bioelectricity*, has announced that Dr. **Ross Adey** of the VA Medical Center in Loma Linda, CA, and Dr. **Jocelyne Leal** of the Ramón y Cajal Hospital in Madrid, Spain, have become assistant editors of the journal. Dr. **Jerry Phillips**, who recently joined Adey's lab, is stepping down as an assistant editor....Dr. **Keith Florig** has left Carnegie Mellon University to join the Arms Control and Disarmament Agency in Washington, DC....Dr. **Sol Sax**, formerly chief physician at Ontario Hydro, is now director of occupational health for Boeing Canada's DeHavilland Division, based in Downsview, Ontario.

CLASSIFIEDS

News About *Microwave News*

Bound Editions

The first five years of *Microwave News* (1981-1985) will soon be available as a bound volume for $450.00. Look for the second volume (1986-1990) in early 1991. For more information, contact: Jennifer Goren at (212) 517-2800.

Ten-Year Index

We are currently planning a ten-year index of *Microwave News*. We are trying to gauge interest in this effort. If your company or agency is interested in sponsoring the index, please call Louis Slesin at the number above.

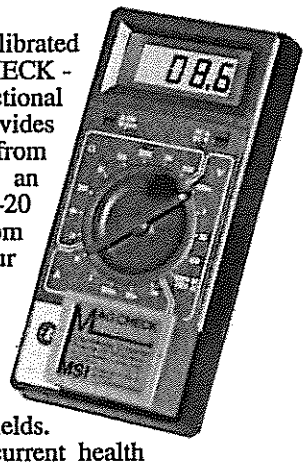
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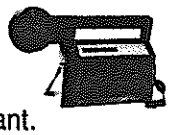
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MICRO WAVE NEWS

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EPA's SAB Panel Seeks To Downplay EMF–Cancer Link

Members of the Environmental Protection Agency (EPA) Science Advisory Board's (SAB) panel on electromagnetic fields (EMFs) plan to recommend a weakening of the agency's finding that EMFs are a "possible, but not proven, cause of cancer in humans" (see *MWN*, N/D90).

The panel, officially known as the SAB's Non-Ionizing Electric and Magnetic Fields Subcommittee, held its second meeting, April 12-13 in San Antonio, TX, to review EPA's draft report, *Evaluation of the Potential Carcinogenicity of Electromagnetic Fields.*

Many panel members argued that the executive summary of the EPA report assumes an increased cancer risk, which is not supported by the rest of the document, and that, in general, the report reveals a bias toward a positive association between EMFs and cancer. Dr. Bary Wilson spoke for many of his colleagues on the panel when he recommended that the report should be made "a lot less inflammatory." Interestingly, the formal classification of the cancer risk, a hotly debated issue when the draft was first released in June 1990, was hardly mentioned (see *MWN*, M/J90).

Some EPA staffers, however, left the meeting believing that the panel's recommendation to include recent studies showing an EMF–cancer link—particularly the one by Dr. John Peters of the University of Southern California in Los Angeles, and several on male breast cancer (see *MWN*, J/A90, J/F91 and M/A91)—would strengthen the report's conclusion of an in-

(continued on p.12)

Congressional Panel OKs EMF Funds, Cautions EPA on Cancer Report

The U.S. House of Representatives' Committee on Science, Space and Technology has authorized $2.2 million for electromagnetic field (EMF) research. In the process, the committee warned Environmental Protection Agency (EPA) Administrator William Reilly that the credibility of the agency's draft assessment of EMF–cancer risks is being threatened by White House "intervention" and by industry-related lobbying.

The committee's Subcommittee on Environment, chaired by Rep. James Scheuer (D-NY), is planning a hearing on EMFs for late July, according to a congressional aide. It was originally scheduled for June 25 but was postponed to allow staff more time for preparation. The agenda has not yet been set. Last year, the Scheuer subcommittee held a hearing on EMF funding legislation (see *MWN*, J/A90).

On May 22, the committee approved without significant opposition an amendment by Rep. George Brown (D-CA), the committee chairman, giving

(continued on p.14)

« Power Line Talk »

The number of cancer clusters anecdotally linked to EMFs continues to grow (see *MWN*, S/O90), with three new clusters reported in California and one in Pennsylvania. In **Fresno, CA**, school officials have agreed to close part of an elementary school within 110 feet of a 230 kV power line. "Even though we don't have conclusive evidence, we are going to move ahead," the school district administrator told *The Fresno Bee* (May 15). The decision came after teachers and parents protested, charging that ten teachers and aides who worked in the ten classrooms closest to the line developed cancer—two have died—during the past decade. In **Garden Grove, CA**, 11 of 65 Pacific Bell employees who worked in a basement office developed cancer, while there were no cases among the 75 workers on the next floor. The basement office is adjacent to a room in which electricity brought into the building is converted to run telephone systems (see also letter from Richard Tell on p.12). VDTs are also used in the basement. "I do believe these [EMFs] could very possibly have something to do with it," one worker told the Associated Press's (AP) Lee Siegel, who reported on the cluster in a three-part, widely-syndicated story starting on May 5. Pacific Bell officials told Siegel that they never thought to measure EMFs from the power room or from the VDTs. A union official has suggested several possible causes of the cluster, including automobile emissions from waiting cars lined up near a basement office window. In **San Jose, CA**, county health officials are planning to study five cancer cases—four of which have been fatal—in an office building near a power line, according to an AP report appearing in *The Los Angeles Times* (May 23). Previous investigations addressed the building's air and water quality. In **Scranton, PA**, residents suspect that four cases of cancer and fives cases of Hodgkin's disease within one neighborhood were caused by a nearby 69 kV power line. "It's very frightening and there's too much for it to be a coincidence," the mother of a 10-year-old with lymphoma told the *Sunday Independent* (January 13) of neighboring Wilkes-Barre, PA. At the residents' urging, U.S. Senator Arlen Specter (R-PA) has asked the Centers for Disease Control to investigate. Pennsylvania Power & Light, which owns the line, has agreed to work with local residents on a panel to consider how to resolve the controversy. Scranton Mayor Jim Connors brought the local concern to a national audience when he testified in January before EPA's Science Advisory Board panel evaluating the agency's EMF report (see *MWN*, J/F91 and p.1).

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Rumors that the **National Cancer Institute** (NCI) has banned its scientists from appearing as expert witnesses on EMFs have been confirmed (see *MWN*, J/F91). Dr. **Elliott Stonehill**, NCI's chief ethics officer, told *Microwave News* that the NCI now has a policy of denying requests from staff members to testify in EMF cases. In 1988, three NCI scientists—Drs. Stuart Aaronson, Lucius Sinks and Margaret Tucker—violated NCI limits on outside income by testifying for the New York Power Authority and were later reprimanded (see *MWN*, S/O88, N/D88, J/F89, S/O89 and J/F91). "We misjudged the political sensitivity of the situation," Stonehill said. In an interview with *The Scientist* (May 27), Stonehill said that, "At the time, we thought we knew what the scientific evidence said about the issue. But it later became clear that we didn't know the answers."

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Two new EMF mitigation research projects are under way. **Power Technologies**, Inc. (PTI), of Schenectady, NY, submitted the winning proposal to the **Florida Department of Environmental Regulation** (DER). The one-year contract is not yet final, but sources say it is likely to be for several hundred thousand dollars. According to Dr. Kenneth Klein of Energetics in Columbia, MD, who is managing the project for the DER, PTI will review current and proposed mitigation line designs—looking at both overhead and underground options—and evaluate their effectiveness in Florida's environment of high salt spray and frequent lightning. (Klein used to run the DOE's EMF program.) PTI will recommend two mitigation designs each for 230 kV and 500 kV lines. Funding for the study will come out of $1 million provided by the **Florida Electric Power Coordinating Group**, a utility lobbying association. PTI is an employee-owned company formed more than a decade ago by former GE workers. On a much smaller scale, on March 11, **EPA** hired **ICF**, Inc., a Fairfax, VA, consulting firm, to assess which consumer product manufacturers are taking steps to reduce EMFs. So far, only VDT makers and electric blanket companies are changing their products because of perceived consumer concerns about EMFs, reports an EPA staffer who declined to be identified. The limited findings have led EPA officials to question whether the informal survey should continue, he said. At most, EPA expects to spend about $25,000 on the effort....On September 10, **Washington state's** EMF task force will hold a one-day **symposium** in Seattle to address EMF mitigation techniques. The meeting is free and open to the public. By January 1992, the task force, as required under state law, must recommend to the legislature ways to reduce human exposures to EMFs (see *MWN*, M/J90). For more information, contact Patti Waller at (206) 586-7663.

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Congressional clout rests in committee chairmanships, and two new chairmen have EMFs on their agendas. Rep. **George Brown** (D-CA), who is now running the House Science, Space and Technology Committee, has shown a continuing interest in EMF health effects and recently sponsored an amendment allocating $2.2 million for EMF research. Brown's staff report-

edly has met with other members of the committee interested in EMFs, including Rep. **James Scheuer** (D-NY), whose Subcommittee on Environment is planning a hearing on EMFs for late July (see p.1). The resignation of Rep. **Morris Udall** (D-AZ) has put Rep. **George Miller** (D-CA) in charge of the House Interior and Insular Affairs Committee. In 1987, Miller held a hearing on the health effects of power lines, promising that, "We are not going to let the issue die" (see *MWN*, N/D87). Miller had scheduled a hearing for mid-January to investigate charges that the White House had interfered with the release of EPA's draft review report on EMFs and cancer (see *MWN*, N/D90 and J/F91); it was canceled because of the start of the Persian Gulf war. A Miller aide told *Microwave News* that EMFs "are on our agenda. It's an issue that we will continue to look into." Among the Interior Committee's members are Rep. **Peter Kostmayer** (D-PA), who held a hearing on EMF research last spring (see *MWN*, M/A90). What all this adds up to is a growing likelihood that EMFs will attract unprecedented attention in the 102nd Congress.

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With the Cambridge, MA-based **Health Effects Institute** (HEI) emerging as the leading candidate to coordinate a major public–private EMF research program (see *MWN*, M/A91), the institute is drawing scrutiny from all sides. Some who argue that federal funds should be kept separate from industry support are circulating an article that is critical of the HEI's public–private program on asbestos, Health Effects Institute-Asbestos Research (HEI-AR). In "The HEI-AR: Who is Affecting Whom?" (*Asbestos Issues*, January 1991), attorney **Edward Westbrook** of the Charleston, SC, law firm of Ness, Motley, Loadholt, Richardson & Poole questions the project's closed-door operations, the use of paid asbestos industry witnesses on HEI-AR's scientific review panel and the project's "resistance to any criticism, even constructive criticism." Westbrook concludes that HEI-AR should face congressional scrutiny if it refuses to change its ways. Dr. **Andrew Sivak**, HEI's executive director, shrugs off the charges. "I am confident that when the HEI-AR report is released, the unbiased nature of the panel and the fair and balanced content of the report will be apparent," he told *Microwave News*. On another front, a New Jersey EMF activist is starting a letter-writing campaign "to legislatures throughout the U.S. to stop [the HEI] from becoming a middleman in the EMF arena." In a letter to fellow activists, **Eileen Kotter** of the Center for Public Information on Electromagnetic Radiation in East Brunswick, NJ, wrote that, "Allocating DOE and EPA EMF research monies to an organization with no previous experience in this area has many people wondering who staged this event."

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The **HEI** will hold the first meeting of its feasibility study group June 11-12 at the Bostonian Hotel in Boston, MA. In early May, Dr. **Richard Setlow** of the Brookhaven National Labs in Upton, NY, agreed to serve as chairman of the project's feasibility study committee. Setlow is best known for his work on ionizing radiation, though he previously chaired a National Academy of Sciences–National Research Council panel on ELF effects (see *MWN*, M/A89). The other committee members are: NCI's Peter Blumberg; Charles Ehret of General Chronobionics, Inc.; Theodore Litovitz of the Catholic University; Martin Misakian of the NIST; William Moloney of Boston's Brigham & Women's Hospital; Richard Nuccitelli of the University of California, Davis; Russel Reiter of the University of Texas Health Science Center, San Antonio; Jeffrey Saffer of the Jackson Laboratory; David Savitz of the University of North Carolina, Chapel Hill; Asher Sheppard of the VA Hospital in Loma Linda, CA; Thomas Tenforde of Battelle Lab; and James Weaver of MIT. The HEI has also set up an Observers' Study Committee, which includes representatives from the CDC, DOE, EPA, EPRI, FDA's CDRH, NCI, NIEHS, NIOSH, Southwest Research Institute and the House of Representatives' Subcommittee on Environment. According to HEI's Sivak, a draft research plan should be completed by November. The HEI has closed the meeting to the press because, according to Sivak, participants should have a "candid, open discussion." Sivak also said that the institute still has not received funding from EPA, though he is confident that it will come through any day.

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The **FDA's CDRH** has set up a working group to coordinate the agency's work on ELF fields. According to the center's Dr. **Alan Anderson**, five different offices at the CDRH handle at least one aspect of ELF EMFs and the working group will "ensure coordination." Another CDRH staffer participating in the working group noted that its formation is an indication that the center is paying "a little more attention" to EMFs.

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Residents of **Beckton**, in east London, **U.K.**, are campaigning to remove a 400 kV overhead power line which they believe has caused increased rates of cancer and a case of mild epilepsy, as well as headaches, depression and lethargy. There is "a buildup of tension and fear" around EMF effects, the Beckton Residents Association's chairman, Gordon Marcham, told *The Independent*, a daily newspaper. He added, "Nobody will buy your house." **National Grid**, the British electricity distribution company, estimates that it would cost as much as £60 million ($102 million) to bury the line. The company insists that the link between EMFs and ill health is unfounded. But **Powerwatch**, a British watchdog group, calculates that EMF exposure from the power line is almost 150 times greater than the threshold level at which health is affected, based on epidemiological studies. Concern in England over the health effects of EMFs made headlines a year ago, when Great Yarmouth, a city on the coast of East Anglia, rejected a proposed overhead transmission line (see *MWN*, J/A90).

NIH Seeks Proposals for EMF Research

Citing widespread public exposures to extremely low frequency (ELF) electromagnetic fields (EMFs) and growing concerns about their possible hazards, the National Institutes of Health (NIH) is soliciting proposals for research on ELF EMF bioeffects. The request was issued "to encourage and foster investigator-initiated basic and applied research on the possible health effects of EMFs" from power lines and appliances, according to the program announcement.

The National Institute of Environmental Health Sciences (NIEHS), the National Institute of Neurological Disorders and Stroke (NINDS) and the National Institute of Child Health and Human Development (NICHD) published a joint request for EMF proposals from individual researchers (R01) and from young investigators (R29) in the May 17 *NIH Guide*.

"We are trying to solicit the scientific community to become more involved in this area," NIEHS's Dr. Michael Galvin told *Microwave News*. He stressed that, even though NIEHS closed down its internal research effort a few years ago, the institute is "very interested in receiving applications" (see *MWN*, J/A87).

Galvin's call for proposals was echoed by NINDS's Dr. Eugene Streicher. "There is a feeling that NIH is not sympathetic to EMF proposals, but that is not necessarily so. We are genuinely interested," he said in a telephone interview. However, Streicher noted that there is no money earmarked for EMF research and that applicants will have to compete with all those submitting proposals for all other research areas. He attributed the impetus for the NIH initiative to congressional interest.

"It's a good sign, but it would be even better if NIH set aside a pot of money exclusively for EMF research," Dr. George Harrison of the University of Maryland School of Medicine in Baltimore told *Microwave News*.

Some researchers are expressing concern that most of the review panels do not have expertise in EMFs and therefore may not be in a position to judge proposals adequately.

Nevertheless, there already are signs that the climate for EMF research at NIH is changing. NIEHS recently awarded a five-year, nearly $2 million grant to Drs. Ann Henderson of Hunter College and Reba Goodman of Columbia University, both in New York City, for a study titled, "Does Exposure of Human Cells to EMFs Cause Cancer?"

In addition, Dr. Stephen Cleary of Virginia Commonwealth University in Richmond has received an $834,000, four-year grant from NIEHS to study "Radiofrequency (RF) Radiation Cellular Mechanisms." Cleary told *Microwave News* that he will use the money "to determine the mechanism of RF-induced cell proliferation" (see *MWN*, M/A90).

In its May 17 announcement (PA-91-53), NIH called for basic research proposals which are designed to:

A. Determine the effects/mechanisms of action of EMFs on cellular responses such as DNA synthesis, modulation of ion binding and interaction with hormones and growth factors.
B. Determine the effects on cancer processes in vivo and in vitro.
C. Determine the effects of EMFs on reproductive/developmental and nervous systems in vivo and in vitro.
D. [Develop] well-characterized EMF exposure systems for assessing biological effects.

When asked to compare the NIH program to that of the Electric Power Research Institute and the one being developed by the Health Effects Institute, Galvin said that the NIH program will have a "broader focus," adding that, "We are going to let the scientific community determine the areas we address."

In late 1988, the National Cancer Institute (NCI) announced that it would sponsor an epidemiological study of the possible link between childhood cancer and EMFs (see *MWN*, J/F89). At that time, a number of NCI scientists dismissed EMF health risks as paid witnesses, later prompting NCI ethics officials to bar NCI staff from consulting on EMF issues (see p.2).

Last year, the National Toxicology Program, in which NIEHS is a participant, announced plans for a $6-10 million program for animal studies on the reproductive, developmental and carcinogenic effects of ELF EMFs (see *MWN*, S/O90).

Inquiries should be directed to: Dr. Michael Galvin, Program Administrator, Scientific Programs Branch, NIEHS, PO Box 12233, Research Triangle Park, NC 27709, (919) 541-7825; Dr. Eugene Streicher or Dr. Watson Alberts, Division of Fundamental Neurosciences, NINDS, Federal Building, Room 916, Bethesda, MD 20892, (301) 496-5745; and Dr. Felix de la Cruz, Chief, Mental Retardation and Developmental Disabilities Branch, NICHD, EPN, 631, Bethesda, MD 20892, (301) 496-1383.

Three States Consider Power Line Moratoriums

State legislators in Michigan, Rhode Island and Tennessee have introduced bills to ban power line construction temporarily. The proposed moratoriums are part of a flood of state and local actions to regulate EMF exposures (see opposite page).

The Rhode Island Senate and House of Representatives are expected to vote on moratorium legislation before the current session ends in June, while the Michigan and Tennessee proposals will probably not move out of committee, sources say.

Rhode Island Bills out of Committee

The Rhode Island legislation, introduced by Senator Michael Lenihan and Rep. Steve Hernandez, both Democrats, would impose a three-year ban on new power lines above 60 kV, to allow time for research efforts "to establish whether exposures to [EMFs] caused by electrical utility generating and transmission facilities present a risk to the health, safety and welfare of the citizens of Rhode Island." The legislation has been passed by the Senate and House Health, Education and Welfare Committees and is awaiting further action. "The fact that the evidence is inconclusive is enough to warrant a moratorium," Hernandez told *Microwave News*.

The Narragansett Electric Company, which will be forced

Other State and Local EMF Actions

Cities and states across the nation are moving to study, regulate and mitigate electromagnetic fields (EMFs), creating a flood of state and local legislation. At the same time, utility regulators are responding variously, funding research and requiring changes in transmission line designs, among other moves. Mohammad Harunuzzaman of the National Regulatory Research Institute (NRRI), writing in the *NRRI Quarterly Bulletin (12*, pp.47-56, March 1991), concludes that, "The public concern over health risks due to EMFs continues to grow and is likely to become one of the important environmental/public health issues of the nineties." Described below are a number of recent actions taken in response to the growing public concern over EMFs. (See also *MWN*, M/J89 and p.4.)

California...Senator Herschel Rosenthal's SB 920, introduced March 8, would require the Public Utilities Commission (PUC) to conduct a $4 million research and education program on EMF health effects, with up to $200,000 coming from the state and the balance to be paid by utilities. The research would determine whether EMF-exposed workers or children attending schools close to high voltage power lines are at risk. The bill would also direct state-owned utilities to develop mitigation techniques and programs to respond to customer EMF inquiries. The Senate Energy and Utilities Committee amended and approved the bill by a vote of 6-0 on April 23.

Colorado...On March 12, the Public Service Company (PSC) of Colorado announced that it will fund a $55,000 literature review on EMF health effects. Five experts from the University of Colorado, Colorado State University and the University of Denver will direct the independent analysis, according to PSC spokesman Mark Stutz.

Connecticut...Senate Majority Leader Cornelius O'Leary is sponsoring SB 633, which, as amended, would require public utilities to contribute $150,000 to an existing EMF task force for a literature review to set state EMF research priorities and to hire experts to develop a policy of prudent avoidance. The bill was reported out of committee and will now be considered by the full Senate.

Illinois...On April 12, Senator Arthur Berman introduced the Safe Power Transmission Act, SB 1436, which would require utilities to relocate any high voltage transmission line that is within 500 feet of an elementary or secondary school and which would set a 2 mG power line EMF limit for residential property. No action is expected this legislative session, according to a spokesman for Berman....On February 5, the town of Wilmette passed an ordinance limiting EMFs from a new Chicago Transit Authority substation to 2 mG at the edge of the property.

Maine...On February 20, Rep. Conrad Heeschan introduced LD 703, which would require EMF warning signs on all pad-mounted transformers and utility substations. The bill would also require the Department of Health and Human Services to survey ELF exposures in and around elementary schools and to report back to the legislature by March 1, 1992. The bill was approved by the House but has run into opposition in the Senate, according to a legislative aide.

Massachusetts...On March 25, six members of the House of Representatives announced the formation of the Legislative Task Force on Electromagnetic Radiation Hazards to study EMFs and to consider legislative initiatives....Several bills pertaining to EMFs were introduced into the legislature: Rep. Barbara Gardner's H 4331 would direct the Energy Facilities Siting Council to investigate EMF health effects, mitigation techniques and possible siting guidelines with up to $2 million from public utilities. Rep. Robert Koczera and Senator Robert Durand's H 2629 would "enhance public participation in energy planning decisions." Rep. Lida Harkins's H 3528 would empower the commissioner of the Department of Labor and Industry to establish video display terminal (VDT) EMF standards and would require employers of more than 25 people to offer pregnant women alternative work.

Missouri...On January 15, citing fears of EMF health effects on people and animals, the Linn Creek Board of Aldermen passed an ordinance prohibiting the construction of any 161 kV transmission lines, thereby blocking the construction of a 3.2-mile line, 700 feet of which would have passed through the town.

Oregon...Senator Grattan Kerans's SB 861 would require utilities to consider mitigation techniques when building high voltage power lines and would direct the Energy Facility Siting Council to set up a committee to monitor EMF research. The bill has been approved unanimously by the Senate. A companion bill, HB 3282, was proposed by Reps. Bill Dwyer and Lisa Naito. Naito also introduced HB 3363, which would require that the results of any study of EMF health effects by a state-funded organization be reported to the legislature. Rep. Thomas Mason's HB 3227 would require the Department of Human Resources to study the effects of EMFs from, among other sources, television, radio, cellular, microwave and satellite communications transmitters.

Washington...Six bills addressing concerns over power line siting and EMF health effects were introduced during the legislative session, which ended in April. Rep. Bill Grant's HB 1613 would have given jurisdiction over power line siting to the Energy Facility Site Evaluation Council. It also may have annulled the power line siting initiative approved by Whatcom County voters in November (see *MWN*, N/D90). Rep. Bruce Holland's HB 1547 would have prohibited increases in EMF levels from new or upgraded lines. Both bills, along with SB 5877, SB 5680, SB 5714 and HB 1198—all addressing EMFs—died in committee. Meanwhile, House Joint Memorial 4007, urging the President of the United States and the U.S. Congress to provide "additional funding to...resolve the growing concern about possible health effects from [EMFs]," was passed....In February, the Bonneville Power Administration (BPA) placed a two-year moratorium on approving new uses for transmission line right-of-ways (ROWs)—e.g., for playgrounds. In a press release, the BPA explained that, "The change is being made due to the controversy over whether exposure to EMFs from the operation of high voltage electrical equipment is a health hazard."

Pennsylvania PUC Ordered To Hold Hearing on 230 kV Line

Pennsylvania's top court has ordered the state's Public Utilities Commission (PUC) to hold a hearing within 90 days to consider the possible electromagnetic field (EMF) health effects of a 230 kV high voltage line that the PUC approved in February 1990.

On May 24, Judge Madaline Palladino ruled that the PUC should have considered the Philadelphia Electric Company's (PECO) application for the 12.8-mile Heaton–Woodbourne line as a request for a new use of an existing right-of-way (ROW) and not as an upgrade, as PECO had sought. Until 1986, Conrail operated a 138 kV line on the ROW to power its trains, according to a PECO spokesman. The utility began construction on the Heaton–Woodbourne line in the summer of 1990 and expects to complete work by this fall.

The PUC's review procedures for new lines are more thorough, and the siting requirements are more stringent, including a wider ROW. The Heaton–Woodbourne line, which would cross parts of Bucks and Montgomery Counties, north of Philadelphia, will have an ROW as narrow as 60 feet in some areas.

Parents Against an Unsafe Environment (PAUSE), the citizens' group that challenged the PUC's actions, wants the PUC to consider possible EMF health effects on people living near the ROW. Earlier this year, the PUC rejected, by a 3-2 vote, PAUSE's petition to reconsider its February 1990 decision and to hold a public hearing. In its ruling, the PUC majority concluded that the scientific evidence on EMFs is inconclusive and did not justify reopening the Heaton–Woodbourne docket. In May, the PUC rejected an appeal by PAUSE.

The PUC and PECO have not yet decided whether to appeal Judge Palladino's ruling.

to postpone plans for a new 115 kV line if the moratorium is adopted, "firmly believes that transmission lines are not a public health problem," according to Robert McCabe, the company president. "The legislation is an overreaction," he said in an April 9 letter to members of the Senate.

The moratorium, proposed in identical bills in the House and the Senate, is modeled after an East Greenwich, RI, town ordinance that was enacted in November (see *MWN*, N/D90 and J/F91). Following East Greenwich's lead, power line bans have been enacted in the towns of Coventry and Foster, and are being considered by the West Warwick and North Kingstown town councils. Rhode Island Superior Court Judge Patricia Hurst recently nullified the East Greenwich ordinance, ruling that the town council lacked jurisdiction over power line siting. Though the decision will be appealed to the state Supreme Court, the issue will be "moot" if the proposed statewide moratorium becomes law, Amato DeLuca, the town's attorney and the author of the ordinance, told *Microwave News*.

Michigan Ponders Study Committee

In Michigan, Republican Rep. Glenn Oxender has proposed a two-year ban on construction of power lines of 100 kV or more. The bill would prevent the construction of a $105 million, 115-mile, 345 kV transmission line from Battle Creek, MI, to Akron, IN, sought by the Consumers Power Company. "The government needs to get involved with this issue because people cannot handle it themselves," Oxender told *Microwave News*. While it is unlikely that the moratorium will be enacted this year, the state legislature will probably pass a resolution to set up a joint House–Senate committee to study power line EMF health effects and to issue recommendations to the legislature by December 31, 1992, according to Oxender.

At least eight towns and counties along the proposed Consumers Power line route have passed resolutions opposing the project, and Residents Against Giant Energy (RAGE) have asked the Federal Energy Regulatory Commission (FERC) to block the line, citing "dozens of scientific studies indicating that the emissions from high tension power lines...may be harmful to humans and livestock." Two U.S. congressmen from the state, Democrat Howard Wolpe and Republican Fred Upton, have voiced support for RAGE in letters to FERC.

Tennessee Town Sets 4 mG Limit

Companion bills, proposed by Tennessee Senator Keith Jordan and Reps. Beth Halteman and Clint Callicott, all Republicans, would ban the construction of high voltage power lines within one-half mile of any occupied dwelling or proposed subdivision. The bills would also require the state Department of Health and Environment to review EMF health effects data, conduct studies, if necessary, and report back to the Assembly by January 1, 1995. The bills were referred to a study committee and will probably not be passed this year.

On April 8, the town council of Brentwood, TN, passed the strictest power line EMF limit in the nation, prohibiting EMF "spillage" from power lines of 120 kV or greater from exceeding 4 mG at the edge of a right-of-way (ROW). The action came in response to Tennessee Valley Authority (TVA) plans to construct a 161 kV line alongside an existing 161 kV line that runs through the town.

The 4 mG limit was based on TVA estimates of EMF levels at the edge of the ROW if the new line were to be erected on the same set of poles as the existing line, Brentwood Mayor Joe Sweeney told *Microwave News*. The TVA, however, will continue with its plan to erect a new set of poles for the line, which it hopes will be operational by July, TVA spokesman Frank Cason said in a telephone interview.

"We'll have to wait and see what happens once the line is energized," Cason said when asked if the TVA will challenge the ordinance, adding that, "A lot of people down here think that it's unenforceable." New York State has an interim 200 mG edge-of-ROW magnetic field limit, while Florida has a 150-250 mG limit (see *MWN*, J/A90 and p.7).

Power Line EMFs Scrutinized in Australia

In Australia, two new surveys of electromagnetic field (EMF) health effects data have fueled controversies over power line siting and EMF exposures.

A research review commissioned by the New South Wales (NSW) government concluded that no firm EMF–cancer link has been established but advised caution with regard to public exposures, while a meta-analysis sponsored by the Victoria Health Department linked power frequency fields to a statistically significant increased risk of childhood cancer.

In February, former High Court Chief Justice Sir Harry Gibbs, director of the NSW *Inquiry into Community Needs and High Voltage Transmission Line Development*, released the survey results, concluding that, "It has not been established that electric fields or magnetic fields of power frequency are harmful to human health, but since there is some evidence that they may do harm, a policy of prudent avoidance is recommended." Gibbs also advocated "actively involv[ing] the community" in power line siting decisions.

In the course of his investigation, Gibbs contacted academics and community activists throughout Australia, reviewed a broad sampling of published studies and met with utility representatives and EMF researchers in Canada, Japan, the U.K. and the U.S. Though the investigation was originally intended to cover "the range of community concerns" about high voltage transmission lines, the 163-page report focuses principally on the EMF issue—of the 177 submissions considered by the investigators, 122 addressed EMF health effects.

The Victoria meta-analysis, released in December, identified a statistically significant doubling of the risk of cancer among children exposed to high levels of 50-60 Hz fields. The analysts, Ian Gordon, Milena Motika and Dr. Terry Nolan, were unable to arrive at any conclusions on residential or occupational EMF exposure and cancer in adults (see p.8).

Following the release of the meta-analysis, Maureen Lyster, Victoria's health minister, announced the formation of an independent panel to advise the government on power line EMF health risks. "This is an area in which much work is yet to be done before any conclusions can be drawn," Lyster said, adding that, "It is an issue that must be seen globally, not just locally."

Panel chairman Hedley Peach of Melbourne University, W.J. Bonwick of Monash University in Clayton and Roslyn Scanlan, a community health worker, will review relevant data both from Australia and overseas, consult with scientists and meet with local action groups and community organizations before issuing recommendations in late 1992. The group will also compile a pool of educational material and strive to promote a better public understanding of EMFs and possible health risks.

A spokesman for the State Electricity Commission of Victoria (SECV) denied a public health risk, stating that, "From our understanding, there is no association between exposure to magnetic fields and any health effects at any level," according to *The Age* (January 29), a Melbourne daily. On February 3, Melbourne's *Sunday Herald* reported that, after meeting with trade unions, the SECV softened its stance and was launching an investigation into the potential EMF health risks faced by its 18,000 workers.

The EMF health debate is not new in Australia. In 1989 Dr. Ken Joyner of Telecom Australia Research Laboratories in Clayton, Victoria, called for further research into the issue and recommended that "no group in the community should be exposed to environmental levels of ELF magnetic fields significantly in excess of those already experienced by other groups in the community." Also in 1989, Dr. Vincent Delpizzo of the Australian Radiation Laboratory in Yallambie, Victoria, published a critical review of literature on the subject, concluding that further investigation was warranted (see *MWN*, M/J89 and S/O89).

A number of Australian communities have organized against transmission lines. According to *The Advertiser* (June 2, 1990) of Adelaide, NSW, one public protest in West Australia resulted in a violent confrontation between demonstrators and police. Part of a transmission line scheduled to run from Brunswick to Richmond, in Victoria, was buried following a storm of community objections (see *MWN*, J/A86, S/O86 and J/F87).

Florida To Revisit ROW EMF Limits

The Florida Department of Environmental Regulation (DER) will reevaluate, but not necessarily revise, the state's electromagnetic field (EMF) exposure limits for new power lines as part of an agreement reached on March 25 with Hillsborough County. The limits, which were the first state right-of-way (ROW) levels ever adopted in the U.S., set maximum magnetic field exposure levels of 150-250 mG at the edge of ROWs.

In exchange, the county has withdrawn the legal challenge it initiated when the limits were issued in 1989 (see *MWN*, M/A89). In a December 1989 suit, county lawyers stated that the levels were "approximately 100 times greater than the intensity of magnetic fields, which are suspected to increase the incidence of all childhood cancer by 30 percent and to double the risk of contracting childhood leukemia" (see *MWN*, J/F90).

The reevaluation would, however, have occurred anyway under Florida law, leading an attorney for the department to call the agreement "a little less than a quid pro quo."

Buck Oven of the DER told *Microwave News* that the department will lower the exposure levels if it changes the limits at all. The DER's review will be closely watched by other states and localities that are weighing possible ROW limits (see pp.4-6). New York is the only other state with an ROW limit—an interim standard of 200 mG (see *MWN*, S/O90).

"I expect the DER's decision making will be rational, as it has been in the past," Carlos Alvarez said in a telephone interview. Alvarez, who works for the Tallahassee law firm of Hopping, Boyd, Green & Sams, is representing the Florida Electric Coordinating Group (FCG), a power utility lobby, in the Hills-

Annual DOE EMF Review

The Department of Energy's (DOE) annual review of research on the bioeffects of extremely low frequency (ELF) electromagnetic fields (EMFs) will be held November 3–7 in Milwaukee, WI. The meeting will be cosponsored again this year by the American Public Power Association and the Edison Electric Institute.

Objectives of the meeting are to review current research, identify areas requiring further study and encourage international coordination of research programs. As in the past, the meeting will be open to the public and there will be no registration fee. For further information, contact: W/L Associates, 120 West Church St., Frederick, MD 21701, (301) 663-1915.

borough case.

The attorney for Hillsborough County, Michael Skelton of the Tampa firm of de la Parte and Gilbert, declined to say whether he expects the limits to be lowered. However, he told *Microwave News* that, "There is a much more open mind at DER" than in the past.

Nancy Flemming, chairwoman of Concerned Citizens for Power Line Safety, which is based in Tampa (in Hillsborough County), said in a telephone interview that she is "encouraged because the DER is willing to work with us on this issue. We would rather work something out without litigation." But, she added, "If the DER does not come up with adequate safety standards, we will encourage the county to go back to court." Asked to define "adequate," she suggested a limit of 1.5 mG at the edge of ROWs.

The March 25 agreement is sealed and confidential, but a copy was obtained by *Microwave News*. It states that all of the parties agreed that their resources "would be more productively expended" in reviewing the DER rule than in litigation.

The department must complete its review by June 1, 1992, at which time Hillsborough County can reinstate its legal challenge if it is not satisfied with the outcome. Oven said the department will recommend a work plan to the state Environmental Regulation Commission in July. In addition to the DER and Hillsborough County, the agreement was signed by the Florida Power Corp. (FPC) and the FCG.

The DER's 1989 limits for new lines are 150 mG for lines carrying up to 230 kV, 200 mG for most 500 kV lines and 250 mG for certain double-circuit 500 kV lines, all applied at the edges of ROWs. For electric fields, there is a 2 kV/m limit at the edges of the ROWs at all three line loads and 8, 10 and 10 kV/m limits, respectively, for the three types of lines, *on* the ROWs.

There are separate limits for the 500 kV Lake Tarpon–Kathleen transmission line, part of which runs through Hillsborough County, as a result of negotiations between the state Siting Board and the FPC: daily maximums of 35 mG and 24 mG under normal load conditions where the ROWs are 100 feet and 190 feet, respectively. Levels as high as 229 mG at 100 feet and 154 mG at 190 feet are permitted for up to 15 hours per year.

The levels are controversial, partly because they are significantly higher than limits the DER had proposed a year earlier. In June 1988, the DER recommended daily *average* and *maximum* magnetic field levels of 50 mG and 100 mG, respectively (see *MWN*, M/J88). At the time of the release of the final standards, DER officials explained that the limits were based on engineering—not health—factors (see *MWN*, M/A89).

The 1989 limits resulted from a 1983 law directing the DER to develop public safety requirements for transmission lines following several siting disputes (see *MWN*, J/A83). In 1986, the Siting Board refused to approve the Lake Tarpon–Kathleen line, in part because the DER had not yet adopted EMF limits (see *MWN*, M/A86). That decision was overturned on appeal (see *MWN*, N/D87).

Hillsborough County first filed suit challenging the state limits in March 1989—charging that the levels were "not protective of public health" (see *MWN*, M/A89)—but temporarily withdrew the suit soon after. The suit was reinstated in December 1989. In mid-1990, the county sought and won a postponement of the scheduled administrative hearing to April 1, 1991.

Meta-Analyses Point to EMF–Health Effects Link

Dozens of individual studies point to an electromagnetic field (EMF) health risk, but others do not. Now, five teams of researchers have combined the data from similarly designed studies and have found that these meta-analyses do support a link between EMFs and adverse health effects.

An Australian meta-analysis of epidemiological studies, commissioned by the Victoria Health Department and directed by Dr. Terry Nolan of the Royal Children's Hospital in Melbourne and statisticians Ian Gordon and Milena Motika, both of Melbourne University, found that children exposed to fields as low as 3 mG were more than twice as likely as controls to develop cancer—a statistically significant increase. The researchers, who released a series of analyses in December, could not come to any conclusions for adult residential or occupational EMF exposures (see also p.7).

In a similiar effort, Edward Washburn and researchers at the Harvard School of Public Health in Boston, MA, along with colleagues from the Mount Sinai School of Medicine in New York City and from the University of Pennsylvania in Philadelphia, found that living near power lines was linked to higher risks of all the types of cancer that they examined, according to science writers Barbara Culliton and Robert Pool in the February 21 issue of *Nature*. The association was statistically significant in two cases—a doubling of the risk of central nervous system cancer and a 50% increase in the risk of lymphoma. The researchers also found increased risks for leukemia, childhood leukemia and childhood lymphoma. Washburn presented preliminary results on February 15 at the annual meeting of the American Association for the Advancement of Science (AAAS), in Washington, DC.

Dr. George Hutchison, retired from the Harvard School of

Public Health and now based in Louisville, KY, presented his own meta-analysis at the February Electric Power Research Institute (EPRI) epidemiology workshop in Carmel, CA. He concluded that evidence for a causal association between EMF exposure and cancer is generally weak (see p.13). Hutchison found a statistically significant EMF–cancer link in nearly every group he analyzed—including an overall 33% increased risk of leukemia for children with residential exposures and a 24% increased risk of central nervous system and brain cancers for adults with occupational exposures. Nevertheless, Hutchison downplayed these results, singling out a 144% increase in the risk of central nervous system cancer among children with residential EMF exposures as the only result which "points to a possible association." Hutchison's paper will appear in the proceedings of the Carmel workshop to be published by EPRI.

In a meta-analysis of laboratory studies, Dr. Kay Kimball "found some statistically significant changes in blood chemistry for small animals exposed to [extremely low frequency] ELF fields," she said in a telephone interview from her office at the Baylor College of Medicine in Houston, TX. Kimball, who also presented preliminary results of her work at the February AAAS meeting, combined data from 40 different experiments by six researchers. Of the seven effects she examined, she observed a statistically significant association between electric field exposure and decreases in total blood protein, as well as a "borderline" statistically significant association with eusenophil decreases.

Dr. Andrew Marino of the Louisiana State University Medical Center in Shreveport combined data from eight different multi-generational experiments conducted in the last 15 years and found that mice exposed to power frequency electric fields had a 30% chance of altered development. In a paper recently published in the *Journal of Bioelectricity* (*9*, pp.213-231, 1990), Marino also revealed that the exposed mice were 36% more likely to exhibit an increased variance in development—indicating that extremes in body weights, both high and low, were more likely in the exposed animals. (See *MWN*, M/A86 and N/D87.)

HIGHLIGHTS

U.S. Computer Makers Push for VDT EMF Limits

American computer manufacturers are leading a drive to establish U.S. and European computer industry guidelines for electromagnetic field (EMF) emissions from video display terminals (VDTs). The effort comes in response to consumer demand for low emission VDTs and a growing concern that unless the industry develops its own emissions guidelines, other, stricter limits may be widely adopted. Apple Computer, Digital Equipment Corp. (DEC) and IBM are the campaign leaders.

The computer industry is feeling pressure to write guidelines it finds acceptable because Sweden's VDT EMF limits specify electric field levels that the industry feels are too strict and because proposed New York City Board of Education purchasing guidelines for VDTs may be based on magnetic field levels that are even lower than the Swedish emissions limits. John Chubb, who in late April left IBM to join Apple in Cupertino, CA, said that the industry must realize that, "If we don't come up with something soon, we're going to pay the consequences."

In a telephone interview, Chubb said the Swedish guidelines are "becoming a de facto standard in the U.S." because they are "the only thing that customers can quote." The Swedish guidelines were developed by the National Board for Measurement and Testing, known as MPR—its name was recently changed to the Swedish Board for Technical Accreditation, or SWEDAC (see *MWN*, S/O88, M/J89 and S/O90). U.S. computer industry officials contend that the Swedish electric field levels are unachievable using current technology.

The move toward U.S. VDT guidelines is progressing despite a setback in March, when the Institute of Electrical and Electronics Engineers' (IEEE) P-1140 working group rejected EMF limits that specified the same magnetic field levels as MPR/SWEDAC but less stringent electric field limits (see *MWN*, M/A91). Those levels are now appended to the draft P-1140 measurement protocol for VDT extremely low frequency (ELF) and very low frequency (VLF) fields. Final IEEE action on the document is expected in mid-June.

The emissions limits may be taken up by another IEEE working group, according to Dheena Moongilan of AT&T in Holmdel, NJ, the chairman of P-1140.

At a May 9 meeting in Washington, DC, initiated by IBM and DEC, the Computer and Business Equipment Manufacturers Association, a Washington, DC, trade group, decided to poll its members on whether to endorse the P-1140 draft document. In addition, IBM has asked the European Computer Manufacturers Association (ECMA) to adopt the P-1140 limits. ECMA's Technical Committee 20 on Electromagnetic Compatibility, scheduled to meet by early June, has asked Chubb to submit a paper explaining the rationale for the guidelines.

The P-1140 protocol will be issued as either a one-year or two-year trial-use standard, which requires a less extensive IEEE review process than would a regular standard. In addition, a trial-use standard is easier to revise, according to P-1140 member Don Heirman of AT&T, also in Holmdel, NJ. The document is "on a fast track," he said.

The U.S. Food and Drug Administration (FDA) is watching to see whether the industry can agree on guidelines, according to Dr. Alan Anderson of the FDA's Center for Devices and Radiological Health in Rockville, MD. If it cannot, "then we will have to consider doing something," he said.

The P-1140 working group's draft guidelines for VDT emissions measurements call for magnetic flux density readings, not time-rate-of-change readings, as we reported in our last issue (see *MWN*, M/A91).