Hazards at Work: Men, Women and the Fertility Gamble, by Nancy Miller Chenier. In an early chapter this book-length study outlines reproductive hazards associated with VDTs. Other potential dangers discussed include chemicals, ionizing radiation, and psychosocial hazards. It is available free of charge from the Canadian Advisory Council on the Status of Women, Box 1541, Station B, Ottawa, Ontario, K1P 5R5.

ETC.

People...A number of changes are taking place among the leadership of the Bioelectromagnetics Society (BEMS). Dr. Bill Guy of the University of Washington, Seattle, took over as president of the society in June. The BEMS membership has elected Dr. Don Justesen vice-president, and he will take over as president when Guy steps down next year. Dr. Elliot Postow of the National Naval Medical Center in Bethesda, MD, will retire as editor of *Bioelectromagnetics* after completing the journal's fifth volume. Dr. R.D. Phillips of Battelle Pacific Northwest Labs in Richland, WA, will be the next editor of the BEMS journal; all manuscripts submitted for publication after January 1 should be sent to Phillips. And Dr. Michael Marron, who is replacing Dr. Tom Rozzell at the Office of Naval Research (ONR), will also assume editorship of the BEMS newsletter. Rozzell is off to ONR's office in London....At EPA's Health Research Lab in North Carolina, Dr. Claude Weil, who works on computer models of electromagnetic fields, is leaving the agency for Boeing in Seattle, WA....Dr. Eleanor Adair of the John Pierce Foundation at Yale University has been elected a fellow of the AAAS....And the Canadian Center for Occupational Health and Safety in Hamilton, Ontario, has formed a new section devoted to physical hazards. Dr. Karel Marha will serve as manager and Dr. Shelly Beauchamp as project scientist for the section, which will begin by focussing on the effects of non-ionizing radiation in general and low frequency magnetic fields in particular.

CONFERENCES

August 16-19: ***2nd Annual Meeting of the Society of Magnetic Resonance in Medicine,*** Fairmont Hotel, San Francisco, CA. Contact: SMRM, Radiology Postgraduate Education, Room C324, University of California, San Francisco, CA 94143.

August 23-25: ***IEEE International Symposium on Electromagnetic Compatibility,*** Hyatt Regency Crystal City, Arlington, VA. Contact: Aaron Sullivan, Jr., 7121 Wolf Tree Lane, Rockville, MD 20852.

August 23-26: ***URSI International Symposium in Electromagnetic Theory,*** Santiago de Compostela, Spain. Contact: Dr. J.L. Sebastian, Dept. de Electricidad y Electronica, Facultad de Ciencias Fisicas, Ciudad Universitaria, Madrid (3), Spain.

September 4-6: ***URSI Symposium on Techniques in Studies of Biological Effects of Low-Level Millimeter Waves,*** Herrsching, West Germany (near Munich). Contact: Professor Saul Rosenthal, Polytechnic Institute of New York, Route 110, Farmingdale, NY 11735.

September 5-8: ***13th European Microwave Conference,*** Messezentrum, Nurnberg, West Germany. Contact: Microwave Conference, Convex House, 43 Dudley Road, Tunbridge Wells, Kent, TN1 1LE, England.

September 6-8: ***2nd International Conference on Radio Spectrum Conservation Techniques,*** University of Birmingham, England. Contact: Conference Services, IEE, Savoy Place, London WC2R 0BL, England.

September 12-14: ***36th Annual Conference on Engineering in Medicine and Biology,*** Hyatt Regency Hotel, Columbus, OH. Contact: Alliance for Engineering in Medicine and Biology, 4405 East-West Highway, Suite 210, Bethesda, MD 20814.

September 19-21: ***16th Annual Electronics and Aerospace Conference and Exposition,*** Shoreham Dunfey Hotel, Washington, DC. Contact: Susan Vekich, Honeywell Inc., Aerospace and Defense, Honeywell Plaza, Minneapolis, MN 55408.

October 2-5: ***3rd International Meeting of the Bioelectrical Repair and Growth Society,*** Holiday Inn Golden Gate, San Francisco, CA. Contact: Executive Secretary, BRAGS, 425 Medical Education Building, 36th and Hamilton Walk, Philadelphia, PA 19104.

October 4-6: ***7th International Colloquium on Prevention of Occupational Risks due to Electricity: The Prevention of Electrical Accidents by Influencing Human Behavior,*** Cologne, West Germany. Contact: Secretariat of ISSA-Section and Colloquium, Berufsgenossenshaft der Feinmechanik und Elektrotechnik, Gustav-Heinemann-Ufer 130, D-5000 Koln 51, West Germany.

October 16-20: ***Conference on Electrical Insulation and Dielectric Phenomena,*** Buck Hill Inn, Buck Hill Falls, PA. Contact: Dr. J.K. Nelson, Center for Electric Power Engineering, Rensselaer Polytechnic Institute, Troy, NY 12181.

October 27-28: ***Studying Problems Associated with Video Display Systems,*** Skyline Ottawa Hotel, Ottawa, Canada. Contact: Planetary Association for Clean Energy, 77 Metcalfe St., Suite 607A, Ottawa, Ontario, K1P 5L6, Canada.

November 7-9: ***1983 Satellite Communications Symposium,*** Hyatt Regency Hotel, Atlanta, GA. Contact: Betsy Crawley, Symposium Coordinator, 3845 Pleasantdale Rd., Atlanta, GA 30340.

November 14-17: ***1983 Radio Technical Commission for Aeronautics Annual Assembly and Technical Symposium,*** Marriott Crystal Gateway Hotel, Arlington, VA. Contact: RTCA Secretariat, One McPherson Square, 1425 K Street, NW, Suite 500, Washington, DC 20005.

November 16-17: ***JINA 83,*** (2emes Journees Internationale de Nice sur les Antennes), Nice, France. Contact: J.L. Guiraud, Centre National d'Etudes des Telecommunications, Centre de La Turbie, 06320 Cap D'Ail, France.

December 12-17: ***8th Annual IEEE International Conference on Infrared and Millimeter Waves,*** Carillon Hotel, Miami Beach, FL. Contact: Dr. K.J. Button, National Magnet Laboratory, Building NW-14, MIT, Cambridge, MA 02139.

1984

January 16-20: ***Microwave Signatures in Remote Sensing,*** URSI Commission F Specialist Meeting, Toulouse, France. Contact: Dr. Richard Moore, Remote Sensing Laboratory, University of Kansas Center for Research, 2291 Irving Hill Drive, Lawrence, KS 66045.

January 17-19: ***Instrumentation & Measurement Society Technology Conference (IMTC) '84,*** Aboard the Queen Mary, Long Beach, CA. Contact: Robert Myers, 1700 Westwood Blvd., Suite 101, Los Angeles, CA 90024.

February 20-22: ***Office Automation & You,*** Los Angeles Convention Center, CA. Contact: American Federation of Information Processing Societies,Inc., 1815 N. Lynn St., Arlington, VA 22209.

April 2-5: ***3rd Annual Test & Measurement World Expo,*** Brooks Hall, San Francisco, CA. Contact: Meg Bowen, 215 Brighton Avenue, Boston, MA 02134.

FROM THE FIELD

With this issue Microwave News *is introducing "From the Field," a monthly column featuring contributions of fact and opinion from our readers. We welcome short items of interest to the electromagnetic bioeffects and compatibility communities.*

"From the Field" offers you a quick way to communicate with your colleagues. There is no charge for this service, and we hope you will take advantage of it.

Of course, we continue to encourage our readers to submit letters to the editor on any relevant subject.

The opinions expressed in "From the Field" are those of the author(s) and do not necessarily represent the views of the editors of Microwave News.

Corrections From Battelle Pacific NW Labs

At last fall's Department of Energy contractors' review, Battelle's Dr. R.D. Phillips explained that a high-voltage transformer failed and was not correctly repaired: "The two high-voltage outputs, which are connected to adjacent electrodes in the mouse exposure system, were in phase rather than 180 degrees out of phase as specified." This resulted in lower field strengths than previously stated. The following two letters will be published in a forthcoming issue of Bioelectromagnetics. *We reproduce them here, at Battelle's request, to expedite the corrections in the papers cited.*

An erratum needs to be published in *Bioelectromagnetics* for the paper entitled, "Effects of 60 Hz Electric Fields on Specific Humoral and Cellular Components of the Immune System" 1982, *Bioelectromagnetics, 3,* 341-347 by J.E. Morris and R.D. Phillips.

A malfunction of the transformer used in this study was discovered after publication of this paper. The electric field strength in the mouse cages was 0.15-0.25 kV/m rather than 100 kV/m as reported in the publication. Experiments are planned to repeat this study at 100 kV/m.

James E. Morris, Ph.D.

An erratum needs to be published in *Bioelectromagnetics* for the paper by B.W. Wilson, et al. entitled "Chronic Exposure to 60 Hz Electric Fields: Effects in Pineal Function in the Rat" *Bioelectromagnetics, 2,* 371-380.

A malfunction of the transformers used for this study was detected subsequent to publication of this paper. The unperturbed field strength was 1.7-1.9 kV/m rather than 65 kV/m stated in the paper. A subsequent study at 60 kV/m produced essentially the same results as those observed at 1.7-1.9 kV/m.

Larry E. Anderson, Ph.D.

Biology and Chemistry Department, Battelle Pacific Northwest Laboratories, PO Box 999, Richland, WA 99352.

SHORT COURSES

August 26: ***The Understanding and Application of MIL-STD-461B,*** Arlington, VA. Fee: $295. Contact: R&B Enterprises, 20 Clipper Road, W. Conshohocken, PA 19428, (215) 825-1960.

August 29-30: ***Doppler Radar Meteorology,*** San Francisco, CA. Fee: $585. Contact: Technology Service Corp., 8555 16th St., Suite 300, Silver Spring, MD 20910, (301) 565-2970.

August 29-31: ***Engineering Techniques for Clinical Hyperthermia,*** Washington, DC. Fee: $685. Contact: Continuing Engineering Education, George Washington University (GWU), Washington, DC 20052, (800) 424-9773.

August 30-September 1: ***FCC & CISPR/VDE Compliance Design and Retrofit of Digital Devices,*** Newark, NJ. Fee: $760. Contact: Don White Consultants, Inc. (DWCI), State Route 625, PO Box D, Gainesville, VA 22065, (703) 347-0030.

September 12-16: ***Radar Systems Engineering,*** Washington, DC. Fee: NA. Contact: Continuing Education Institute (CEI) 10889 Wilshire Blvd., Los Angeles, CA 90024, (213) 824-9545 or (301) 596-0111. Repeated • September 19-23: Columbia, MD.

September 12-16: ***Spread Spectrum Communications Systems,*** Washington, DC. Fee: $855. Contact: GWU, see August 29 above.

September 13-15: ***EDP Equipment Design Seminar on Coping with the FCC/VDE Regulations on RFI,*** San Diego, CA. Fee: $695. Contact: EMXX Corp., 6706 Deland Drive, Springfield, VA 22152, (703) 451-4619. Repeated • October 11-13: Boston, MA; • November 8-10: San Francisco, CA.

September 18-24: ***Microwave Measurements,*** University of Kent, UK. Fee: 200-300 pounds, depending on IEE membership and housing needs. Contact: Institute of Electrical Engineering (IEE), Savoy Place, London WC2R 0BL, England, 01-240-1871, ext. 272 or 282.

September 19-21: ***Imaging Equipment Update,*** Chicago, IL. Fee: $150/$250/$300 for 1/2/3 days. (NMR and Nuclear Medicine on the 21st). Contact: Ms. Judy Gallegos, Dept. of Radiology, University of Utah School of Medicine, Salt Lake City, UT 84132.

September 20-23: ***Grounding and Shielding,*** San Diego, CA. Fee: $760. Contact: DWCI, see August 30 above.

September 26-29: ***Electromagnetic Compatibility Engineering,*** East Brunswick, NJ. Fee: $1160. Contact: Center for Professional Advancement, PO Box H, East Brunswick, NJ 08816, (201) 249-1400. Repeated • October 18-21: San Mateo, CA.

September 26-30: ***Electromagnetic Interference and Control,*** Ottawa, Canada. Fee: $855. Contact: GWU, see August 29 above. Repeated • December 12-16: Washington, DC.

September 27-29: ***Grounding, Bonding and Shielding,*** Nashua, NH. Fee: $695. Contact: R&B, see August 26 above. Repeated • October 3-5: Philadelphia, PA; • November 7-9: Atlanta, GA.

October 6-7: ***EMI and ESD Control in Electronic Systems,*** Philadelphia, PA. Fee: $495. Contact: R&B, see August 26 above. Repeated • October 24-25: Boston, MA; • November 10-11: Atlanta, GA.

October 10-11: ***International Requirements for EMI and Product Safety,*** Philadelphia, PA. Fee: $495. Contact: R&B, see August 26 above. Repeated • October 31-November 1: Boston, MA.

October 10-15: ***Advanced Microwave Circuit Design,*** Los Angeles, CA. Fee: $975. Contact: Short Course Program Office, UCLA Extension, PO Box 24901, Los Angeles, CA 90024, (213) 825-1295.

October 11-13: ***Current Issues and Trends in Controlling Occupational Exposures to RF/Microwave Radiation,*** Salt Lake City, UT. Fee: NA. Contact: K. Blosch, Rocky Mountain Center for Occupational and Environmental Health, University of Utah, Salt Lake City, UT 84112 (801) 581-5710.

October 17-18: ***EMI Workshop,*** Philadelphia, PA. Fee: $575. Contact: R&B, see August 26 above. Repeated • December 5-6.

October 17-21: ***Communications Satellite Engineering,*** Washington, DC. Fee: $855. Contact: GWU, see August 29 above.

MICRO WAVE NEWS

Vol.IV No.6 A Monthly Report on Non-Ionizing Radiation July/August 1984

INSIDE...

Past Cancer Studies pp.5-6

HIGHLIGHTS pp.2-3

Magnetic Fields Induce Temperature Changes

Power Stations: EMI and Community Concerns

Appeals Court Lifts Ban on Project ELF Construction...

...AIBS Gets Key Role in Project ELF EIS

FROM THE FIELD pp.9-12

EPA Office of Policy Planning and Evaluation Options Paper for RF/MW Guidance

UPDATES pp.6-8, p.12.

Burgis Radar Case Settled ▫ EMPRESS II on Chesapeake Bay ▫ RFI-Free Satcom Sites ▫ Hazard Assessment Symposium ▫ Magnetic Fields from Household Appliances ▫ ARRL - Cable TV RFI ▫ Power Line Actions in Florida, Nevada and Virginia ▫ EBI v. AME Patent Suit ▫ Regulations for VDT Radiation? ▫ DOE-EPRI-NYS Bioeffects Review ▫ VDT Legislation ▫ Measurement Resources ▫ and more...

Conferences p.12

Classifieds p.8

Microwave News invites contributions to *From the Field*, our occasional column featuring news and opinions from the non-ionizing radiation community. Letters from readers are also welcome.

Microwaves Promote Cancer

Microwaves can promote cancer, according to the first long-term study of microwave exposure ever carried out in the United States. The $4.5 million study revealed that exposures to low levels of pulsed 2450 MHz radiation caused a statistically significant increase in malignant tumors among rats.

The new cancer data come from a five-year study headed by Dr. Arthur W. Guy, the director of the Bioelectromagnetics Research Laboratory at the University of Washington School of Medicine in Seattle. The study was sponsored by the U.S. Air Force.

In addition to a general increase in cancer incidence, the experimental results suggest that microwave exposure is responsible for wide-ranging effects related to the adrenal glands and the entire endocrine system.

If confirmed, the new study would undermine the 1982 American National Standards Institute (ANSI) radiofrequency and microwave (RF/MW) radiation exposure standard. That standard asserts that the level of exposure used in the Guy study is safe.

The findings are far from definitive, but a number of experts found the preliminary and unpublished data highly suggestive of a link between microwave radiation and cancer, possibly through a stress reaction. In numerous interviews, researchers expressed rare unanimity in calling for a replication study because of the serious implications for public and occupational health.

"The bottom line is that the study must be repeated," said Dr. Barbara Chang, a hematologist and oncologist at the Medical College of Georgia in Augusta.

Chang explained that "there is increasing evidence that microwaves may be a tumor promoter," but cautioned that "there is no direct evidence that microwaves can induce cancer." Chang was a member of the ad hoc panel that recently evaluated the Environmental Protection Agency (EPA) literature review of RF/MW radiation bioeffects (see *MWN*, October 1983 and January/February 1984).

The new results lend support to an earlier Polish study which found that microwaves can promote cancer at higher exposure levels. Dr. Stanislaw Szmigielski showed that 2450 MHz radiation can enhance the carcinogenic action of benzopyrene (see accompanying story on past studies).

(Current theories hold that the development of cancer is a multi-step process. An important distinction is made between the induction and promotion of cancer. Induction refers to the initial transformation of the cells that leads to their uncontrolled growth, while promotion refers to the enhancement of that growth process or the survival of the transformed cells.)

Guy's Experiment

Guy and his collaborators exposed 100 male rats to 0.48 mW/cm^2 of 2450 MHz, 8 Hz amplitude modulated pulsed microwaves (10 microsecond pulses, 800 pulses per second) for 21 hours a day for up to 25

(continued on p.4)

Magnetic Fields Induce Temperature Changes

Magnetic fields like those associated with nuclear magnetic resonance (NMR) imagers can induce relatively large changes in the temperature of live mice, according to a recent paper by German scientists. This new, unexpected finding has surprised many leading researchers.

A team working under Professor Klaus Dransfeld of the Department of Physics at Konstanz University measured a detectable increase in rectal and surface temperature of mice placed in a static magnetic field of only 0.4 Tesla (T). The temperature effect begins to saturate in a field of 2 T, with little further heating as the magnetic field is increased to 8 T.

Interestingly, the temperature increase was only observed when the mice were in certain orientations in the magnetic field. In another orientation, there was a *decrease* in temperature as the strength of the magnetic field increased. (Reversing the direction of the magnetic field by reversing the coil current had no effect on the direction of the temperature change.)

The authors cannot explain what biological processes could cause the observed effect. They do note that there is a translational force (proportional to the susceptibility of biomolecules) in inhomogeneous magnetic fields which does change directions like the observed temperature.

In one experiment with a 3 T magnetic field, the rectal and dorsal temperatures of the mouse started to increase in about four minutes. The temperature continued to increase for three hours for a net change of 2.4 degrees Centigrade (C). After the magnetic field was turned off, it took two hours for the temperature of the mouse to return to normal.

Dr. Rudolf Oldenbourg, a co-author of the paper and presently a visiting post-doctoral researcher at Brandeis University's Martin Fisher School of Physics in Waltham, MA, said the group had run the experiment at different times and had always observed the same qualitative response. "Beyond any doubt there is a temperature change due to the magnetic field," he said in a telephone interview.

This study was motivated by a report of observed temperature increases as great as 5 degrees C in humans exposed to fields similar to those of NMR imagers. This observation has not been formally published, but is reported in a working paper cited in Dransfeld's paper. Oldenbourg believes that these temperature increases were measured for exposures to magnetic fields of up to 1.5 T.

In a series of interviews, experts in the field expressed surprise over Dransfeld's experiment. None could offer an explanation for his results and many were incredulous.

Dransfeld's findings could have an impact on the assessment of the risks of NMR imagers, which are using stronger and stronger magnetic fields. For instance, Technicare, a Johnson & Johnson subsidiary, has won government approval to market NMR units with magnetic fields of 0.6 T, and has four machines with 1.5 T fields undergoing trials at various clinics across the country. A spokesman for the company said that units with fields of up to 2.0 T are being tested in-house.

To date, there have been no reports of ill effects due to NMR imagers, from either their static magnetic fields or from their pulsed radiofrequency signals. Indeed, the Food and Drug Administration's Center for Devices and Radiological Health noted in its May *Radiological Health Bulletin* that, "The only significant adverse effect [of NMR imagers] observed was claustrophobia in about four percent of the subjects."

Dransfeld's paper appears in *Naturwissenschaften, 71*, 100, 1984, a prestigious German journal. The paper is written in English. Dransfeld was formerly with the Max Planck Institute for Solid State Physics in Stuttgart and the High Magnetic Field Lab in Grenoble, France.

Power Substations: EMI and Community Concerns

Computers and other electronic equipment in power substations can fail due to electromagnetic interference (EMI) from transients. This is the conclusion of a study headed by Dr. B. Don Russell of Texas A&M University in College Station and sponsored by the Electric Power Research Institute (EPRI). As engineers turn their attention to this problem, citizen groups are showing greater concern over the potential health effects of the EM fields associated with substations.

EMI From Transients

Russell and co-workers have characterized the transients which are caused by the operation of breakers and disconnect switches: the frequencies range from several hundred Hz to more than 200 MHz, with amplitudes of up to 70 kV/m and higher. Though the exception is the rule, a "typical" waveform lasts 10 microseconds, is in the 20 MHz range and has an amplitude of 5 kV/m (electric) and 3 A/m (magnetic). The "typical" transient generated by a 345 kV switch has a rise time of 180 nanoseconds (ns) (electric) and 60 ns (magnetic); for a 500 kV switch, the rise times are 700 ns (electric) and 100 ns (magnetic).

With respect to the EMI shielding that can be provided by a substation control building, Russell's group found an attenuation of about 15 dB in the 10-100 MHz range and up to 20-25 dB in the 1-10 MHz range, though they add that there are "significant holes" in this shielding.

Russell and co-workers warn that transients "represent a significant potential problem in terms of equipment interference...Failures will occur due to these transients; it is only a matter of time."

A brief summary of Russell's findings appears in two papers published in the July issue of the *IEEE Transaction on Power Apparatus and Systems*. The complete report, *Measurement and Characterization of Substation Electromagnetic Transients*, (No. EL-2982) is available from EPRI, Research Reports Center, Box 50490, Palo Alto, CA 94303, (415) 965-4081. Two related papers on a long-term transient monitoring system in a 138 kV and a 500 kV substation and transmission line, by a team headed by M.D. Perkins of Westinghouse Electric Corp. in Pittsburgh, PA, are in the August issue of the *IEEE Transaction on PAS*.

Public Concerns

Citizen concerns about the potential hazards of EM radiation associated with power systems are growing: disputes over substations have joined on-going controversies over transmission lines. The difficulties experienced by New York City's Con Edison and by Florida Power and Light (FP&L) may be an omen for other utilities.

Con Edison is building a substation near the United Nations and across the street from a housing development. A group calling itself HEED (Help End Environmental Danger) has succeeded in drawing attention to the plant, which is now half completed. In June, the City Council heard testimony on a motion to halt construction pending the writing of an environmental impact statement.

Dr. Abraham Liboff of Oakland University in Rochester, MI, testified for HEED arguing for a cautious approach in light of new research showing that magnetic fields are more biologically active than previously thought. A number of local politicians also spoke in favor of HEED's position.

Con Ed says there is no risk, citing measurements from a nearby substation that showed magnetic fields are on the order of a fraction of a milligauss, 80 feet from the station and 30 feet above the street. Con Ed's Dr. Peter Freudenthal told the council that there are 20 other substations in the city and "it would be ridiculous to stop this project." A decision from the City Council is expected soon.

In Coral Springs, FL, the community is trying to stop FP&L from building a substation that has already been shut out from a neighboring community. Citizens wanted to invoke a new state law, authorizing the state Department of Environmental Regulation (DER) to establish safety requirements for power lines (see *MWN*, July/August 1983). But, as DER's Karen Anthony told *Microwave News*, the law does not apply to substations.

Appeals Court Lifts Ban On Project ELF Construction...

A federal appeals court has lifted the construction ban on Project ELF in what may be the final blow to opponents of the Navy's massive land-to-submarine communications system. The June 13 order of the Seventh Circuit Court of Appeals in Chicago suspends a district court injuction against further construction pending completion of a supplemental environmental impact statement (EIS) on the project (see *MWN*, March 1984).

The appeals court is not expected to issue its decision on the project's future until this fall. Meanwhile, the Navy is proceeding with both the project and the mandated study.

The State of Wisconsin and Marquette County, Michigan, the plaintiffs in the original suit, believe that the study will be a pointless exercise if construction is allowed to continue. In an interview shortly after the appeals court ruling, Shari Eggleson, Assistant Attorney General for Wisconsin, explained that the Navy is under no obligation to act on the EIS findings should they show a health risk associated with ELF radiation and that it is extremely unlikely that the study, which is not expected for release until February 1985 at the earliest, will affect a project that is already largely completed.

In a last ditch effort to slow the project, the state and the county applied to the US Supreme Court on August 1 for a stay of the appeals court order — thus reinstating the construction ban — until the court of appeals issues its decision. The plaintiffs filed a similar motion with the appeals court on July 9. As we go to press, neither court has responded.

In the two paragraph order released on June 13, the three judges hearing the appeal stated that "we do not perceive any reason or justification for further delaying the implementation of this national defense project authorized by Congress and directed by the President."

The Navy has maintained throughout the court proceedings that national security will be jeopardized if the project is delayed.

Construction has now resumed at the Wisconsin Project ELF site at Clam Lake, and the Navy expects to award a contract for the transmitter in Michigan by August 31, with construction on the state's Upper Peninsula to begin in September. The Navy originally scheduled to complete the Clam Lake facility in September 1985 and finish all work by April 1986. According to a Navy spokeswoman, the Navy is "currently assessing the impact of the four-and-a-half month delay created by the court-ordered injunction."

...AIBS Gets Key Role in Project ELF EIS

The Navy has chosen the American Institute of Biological Sciences (AIBS) to coordinate the literature review and analysis for the Project ELF supplemental environmental impact statement (EIS). The review will cover the bioeffects literature for extremely low frequency (ELF) radiation published after the Navy's 1977 EIS.

Under a $319,000 Navy contract, AIBS has set up a nine-member panel chaired by Professor H.B. Graves of Pennsylvania State University. Both Graves and an AIBS spokesman told *Microwave News* that panel membership and the topic areas to be covered will not be finalized until mid-August and so they declined to discuss details —including who will serve on the panel.

The panel's report will incorporate material from two key sources. In addition to data provided through the Navy-contracted literature search underway at the IIT Research Institute (IITRI), in Chicago, IL, the panel will solicit research reports from experts in specific topic areas.

Although the AIBS report will include the panel's summary analysis, the EIS and its final conclusions will be written by the Navy. The Navy has set an October 31 due date for the report, but Graves indicated that this date may be hard to meet. Should the Navy's schedule hold, a draft EIS will be filed in mid-November and a final version completed sometime in the February-April period. The Navy is also planning to hold public hearings, probably in December.

AIBS is a 9,000 member not-for-profit scientific and educational organization based in Arlington, VA.

months. The rats, which were housed in a pathogen-free environment, had a maximum average specific absorption rate (SAR) of 0.4 W/Kg. One hundred rats were used as controls.

Guy's results were presented at the annual meeting of the Bioelectromagnetics Society (BEMS) in Atlanta in mid-July by Drs. C.K. Chou and Lawrence Kunz. In two separate papers, they delivered low-key assessments of their findings: a doubling of the weight of the adrenal glands and an excess of total malignancies among the exposed rats. Both effects were statistically significant. The speakers did not link the two effects, however, treating them as independent findings.

Kunz, the group's veterinary pathologist, noted that the incidence of each type of cancer in the rats was not in itself significant. The increase in cancer only became statistically reliable when the data were collapsed into a total cancer incidence index. In addition, he said that the cancer rate was not significant compared to historical controls rather than those actually used.

A Private Meeting

The presentations left much of the audience confused about what the results mean. But a clearer picture emerged later during an informal meeting with Kunz in Guy's hotel suite. Among those attending the briefing were researchers from EPA, the National Institute for Occupational Safety and Health (NIOSH), Dr. Chang, Dr. Don Justesen of the VA Hospital in Kansas City and Dr. Sam Milham of the Washington State Department of Social and Health Services.

Kunz reviewed the cancer data in some detail: There were 16 malignant tumors among the exposed rats, but only four among the controls. He went on to describe each type of tumor.

Based on this list, Chang and Milham immediately deduced a pattern of increased malignancies in the endocrine system. There were seven endocrine neoplasms among the exposed rats compared to only one among the controls: two thyroid, two pituitary and three cortical adrenal tumors. (The adrenal, thyroid and pituitary glands are part of the endocrine system.)

Kunz also revealed that there were six pheochromocytomas or pheos —benign adrenal tumors— among the exposed rats but none in the controls. Pheos secrete epinephrine, a neurotransmitter, and are associated with high blood pressure and headaches. They have also been connected with stress.

Putting the Data Together

The emerging pattern of experimental results differed from the isolated observations presented at the conference. The exposed rats experienced a doubling of their adrenal mass, an increase in the number of adrenal and other endocrine tumors, and an increase in the number of benign adrenal tumors, as well as a general increase in overall tumors.

Two theories were put forward by those assembled in Guy's suite. The observed effects could be caused directly by the microwave radiation, or they could be the manifestation of a general stress reaction brought on by the radiation.

Guy's results could provide an experimental basis for the widely reported complaints among workers chronically exposed to microwave radiation: headaches, dizziness, memory loss and fatigue. These symptoms have become known as "the microwave sickness."

Kunz resisted the notion that his results formed a coherent and consistent picture of adverse effects. He suspected that the increase in cancer was not a true finding. "I doubt that these data are reproducible," he said.

All those present wanted to see the experiment repeated, a desire that would take years to satisfy. "We might be seeing anything from an anomolous lowering of controls to a true difference indicative of non-specific stress," Justesen said.

Milham, an epidemiologist and physician, later summed up the general sentiment of those who had heard the Kunz-Guy briefing: "There appears to be a pattern in the data. It says at minimum that the experiment should be repeated."

One common observation was that Guy's group had not set out to test whether microwaves are carcinogenic — instead they studied a large number of health-related end points looking for any and all ill effects. A second study could be specifically designed to test for the microwave-cancer link.

A Provocative Finding

The results of Guy's experiment are still under review by Air Force officials. One Air Force researcher told *Microwave News* that he would prefer to withhold comment until the tumor analysis had been completed. The raw data, including computer tapes of all the individual data points as well as the pathology slides will be made available to all interested parties, he said.

The Air Force has sent the Guy results to Dr. E.H. Vernot of the Toxic Hazards Research Unit at the University of California at Irvine for an independent analysis. In a letter to the Air Force, Vernot wrote that the "finding of excess malignancies in the exposed animals is provocative."

Guy referred all questions about the biological aspects of his study to Kunz. Guy's chief assistant, Professor Chou said in an interview that, "We are all concerned about this, but we should realize that we had a small sample size." He concluded that "I cannot say that microwaves cause cancer at this time."

For the moment, everyone is anxiously awaiting the publication of Guy's results so that the many explanatory hypotheses already circulating through the research community can be tested.

A description of Guy's experiment and his findings will appear in nine volumes published by the Air Force; a number of these are already available. The findings discussed here are not ready for distribution but should be printed soon as "Volume 8." For more information regarding the availability of copies, contact the Air Force's contract monitor, Jerome Krupp at the USAF School of Aerospace Medicine, Brooks AFB, TX 78235.

Implications for ANSI Standard

The rats in Guy's experiment were exposed to an SAR of 0.4 W/Kg, precisely the SAR level specified by ANSI as safe. "Whole body SARs below 4 W/Kg were not by consensus associated with effects that demonstrably constitute a hazard," the ANSI committee wrote in 1982. A safety margin of ten was then factored in. The frequency dependent exposure guidelines, 1 mW/cm^2 in the 30-300 MHz band, stem from the 0.4 W/Kg level.

More than one of the representatives from the federal agencies who attended the Kunz-Guy meeting noted that the new cancer results, if confirmed, would undermine the adequacy of the ANSI standard.

Past Cancer Studies

While Guy's experiment is certainly the most ambitious study, it is not the first to find a connection between cancer and microwaves. The issue has been and continues to be quite controversial, at least in part because there are so few studies in the bioeffects literature.

As Dr. William Kirk wrote in EPA's soon-to-be-released *Biological Effects of Radiofrequency Radiation*, "Because few RF radiation studies in man or animals have employed life span or cancer as end points and none has had sufficient statistical power and adequate quality control...the questions of RF radiation carcinogenesis or life shortening are still open. None of the complete reports in the literature presents a convincing case for the existence of a significantly increased risk of cancer induction...The data of Szmigielski *et al.*, however, raise the possibility that RF radiation may act as a cancer promoter..."

Szmigielski and co-workers at the Center for Radiobiology and Radioprotection in Warsaw have shown that microwaves can promote cancer: 2450 MHz radiation is a co-carcinogen with benzopyrene (*Bioelectromagnetics, 3,* 179, 1982). They discovered that microwaves accelerated the development of spontaneous and chemically induced tumors in mice. The Polish group concluded that, "It remains an open question as to whether the tumor-accelerating effect observed in mice exposed to MW fields at 5 mW/cm^2 is due to specific interaction of the radiation at the cellular or subcellular level...or to a nonspecific stress and/or adaptation reaction."

The other major paper in the microwave-cancer literature was published in 1962 by Susan Prausnitz and Dr. Charles Susskind of the University of California, Berkeley. They irradiated mice with pulsed 9.27 GHz microwaves (2 microsecond pulses, 500 pulses per second) for four and half minutes a day for 59 weeks at a level of 100 mW/cm^2 and found an indication of leukemia — an increase in neoplasms of the white blood cells (*IRE Transactions on Bio-Medical Electronics, 9,* 104, April 1962). In a 1976 review, the Food and Drug Administration called this experiment "the most discomfiting finding in the available literature." Nevertheless, no attempt has ever been made to replicate the Prausnitz-Susskind study.

Epidemiological Studies

A number of epidemiological studies have suggested a link between microwaves and cancer, though none are considered reliable.

• Dr. William Morton of the University of Oregon in Portland has correlated the incidence of leukemia with extremely low (nanowatt) levels of broadcast radiation (see *MWN,* December 1983). EPA, which funded the study, faulted Morton's analysis and refused to publish his report.

• Drs. John Lester and Dennis Moore of the University of Kansas School of Medicine in Wichita uncovered a pattern of cancer incidence which appeared to be related to exposure to radar radiation, though they warned that the relationship was not strong enough to establish a correlation between the two (see *Journal of Bioelectricity, 1,* 59, 1982 and *MWN,* July/August 1982).

• The 1978 epidemiological study of Americans stationed at the U.S. embassy in Moscow uncovered a relatively high proportion of cancer deaths among female employees. Dr. Abraham Lilienfeld of Johns Hopkins University in Baltimore, MD, the study director, noted that there was also an anomalously high incidence of cancer among women stationed in other U.S. embassies in Eastern Europe who served as controls. Lilienfeld could not explain this finding, but hesitated placing too much importance on it because of the small sample size and the long latency periods associated with cancer induction. The microwave exposures at the embassy in Moscow were very low, in the microwatt range.

In addition, over the last few years there have been eight papers linking leukemia to extremely low frequency (ELF) electromagnetic fields (see *MWN,* March and June 1983). The current consensus among researchers is that the biological action by ELF radiation involves a different mechanism than higher frequency radiation such as microwaves — though the distinction may be blurred when microwaves are modulated at ELF frequencies.

Cancer Clusters in the Workplace

There have been at least two clusters of cancer among workers exposed to microwaves on the job. In each case, the ensuing investigations were inconclusive.

• In 1980, workers at the Communications Workers of America Local No. 4354 in Ragersville, OH, reported that five out of eight members of its AT&T Long Lines Depart-

MICROWAVE NEWS is published monthly, except in January and July • ISSN 0275-6595 • PO Box 1799, Grand Central Station • New York, NY 10163 • (212) 725-5252 • Editor: Louis Slesin, Ph.D., Associate Editors: Martha Zybko, Mark Pinsky • Subscription: $200 per year (overseas $235) • Copyright © 1984 by Louis Slesin • Reproduction in any form is forbidden without written permission.

ment had developed cancer since 1971. NIOSH was called in to study the cluster, but investigators decided that it was an accidental grouping, unrelated to microwaves (see *MWN*, February 1981).

• Also in 1980, the United Paperworkers International Union disclosed a cluster of nine cancer cases among twenty women working on RF sealers at the Beaverite Products Plant in Beaver Falls, NY. NIOSH was again called in but could only identify six cancer cases. The agency did find that the women were exposed to radiation levels far in excess of the then current 10 mW/cm^2 standard. NIOSH decided to terminate the study, because as epidemiologist Terry Leet explained to the union, "There is no convincing evidence in the scientific literature to indicate that RF radiation causes cancer in humans or animals" (see *MWN*, November 1981). NIOSH has been trying to set up an epidemiological study of RF sealer operators for nearly ten years without success.

In the mid-1970's, two radar repairmen at the Naval Air Station at Quonset Point, RI, developed pancreatic cancer and endocrine disorders (the pancreas is part of the endocrine system). One of them, Robert Engell, charged that his condition stemmed from working with Tactical Air Navigation (TACAN) systems and filed a $4.5 million suit against ITT, Raytheon, General Dynamics, Varian Associates and Rockwell International. The suit was settled out of court under the stipulation that the amount of the settlement remain confidential (see *MWN*, November 1982 and January/February 1983). The issue of causality was never addressed in court.

1978 NIOSH Study

In 1978, NIOSH released a literature review of the carcinogenic properties of RF/MW radiation (*Carcinogenic Properties of Ionizing and Non-Ionizing Radiation: Volume II –Microwave and Radiofrequency Radiation*, March 1978). That study found that there was almost no information in the scientific and medical literature.

NIOSH argued in favor of a hypothesis proposed by Dr. Milton Zaret that an increase in cardiovascular disease and an "alleged" rise in cancer incidence in North Karelia, Finland, could be attributed to nearby high-power, Soviet radars (*Medical Research Engineering, 12* 13, 1976). In his analysis, EPA's Kirk discounts this theory as a "misunderstanding/misinterpretation," noting that a Finnish government spokesman has denied any knowledge of increased cancer in North Karelia or of any other microwave-related effect. ●

UPDATES

COMPATIBILITY & INTERFERENCE

ARRL v. Cable TV... The FCC has denied the American Radio Relay League's (ARRL) petition to bar cable television operators from frequencies used by the Amateur Radio Service. Calling the league's proposed solution to interference problems "excessive," the commission ruled that disputes can be solved through cooperation, as demonstrated by the joint special committee (of ARRL, the National Cable Television Association and FCC staff representatives) set up since the petition was filed in 1982 (see *MWN*, October 1983 and March 1984). As outlined in the commission's June 15 decision (No. 84-283 on RM-4040), the league claimed that severe interference, particularly on cable TV Channel E at 144-150 MHz, was "a direct result of cable TV systems using inadequate shielding, low quality components, poor cable installation techniques and inadequate maintenance." While noting "it is clearly the responsibility of the CATV system operator to solve such interference problems," the commission concluded there is "no justification in the record to preclude frequencies" from cable TV use.

RFI-Free Satcom Sites... Spectrum Planning Inc. has come up with a simple way for finding interference-free sites for C-band satellite earth stations. The company's new Pocket Map system can identify locations which are free of RFI from and to 4 and 6 GHz terrestrial microwave systems. Spurious 4 GHz radiation can degrade the operation of satcom receivers, while 6 GHz signals from uplink facilities can in turn interfere with microwave receivers. The Pocket Map system factors in the transmit power, antenna discrimination, antenna centerline and transmission line loss of the terrestrial station with the gain and sidelobe of a standard earth station antenna to find acceptable sites. The technique, which also takes into account predicted propagation losses due to variations in terrain, produces maps which can be placed over USGS regional maps. For more information, contact Spectrum Planning's Randall Oster, 1850 N. Greenville Ave., Richardson, TX 75081, (214) 699-3536.

LITIGATION

Burgis Case Settled... Former Army radar technician Stanley Burgis settled his suit against Western Electric (now AT&T Technologies Inc.) for an undisclosed sum on July 18 (see *MWN*, December 1982). Burgis claimed that radiation from M-33 radar caused cataracts and retina damage. According to Burgis's attorney Gerald McHugh Jr., at the Philadelphia firm of Litvin, Blumberg, Matusow & Young, a condition of settlement is that the terms remain completely confidential. Although McHugh refused to comment on the settlement, a source familiar with the proceedings told *Microwave News* that it was "very substantial." McHugh estimated that his client was periodically exposed to over 40 mW/cm^2 and routinely exposed to 5 to 10 mW/cm^2 during the nine months he worked on the M-33 radar in the early 1950's. These estimates were based on Army and Air Force hazard surveys of other Western Electric M-33 radars. The

case, filed in 1980 before the US District Court for Eastern Pennsylvania in Philadelphia, was scheduled to come to trial on July 31.

EBI Patent Suit... Electro-Biology Inc. (EBI) is seeking over $16 million from the manufacturer and marketers of a bone regenerating system it claims uses the same pulsed electromagnetic fields (PEMFs) as the EBI Bi-Osteogen unit. In a complaint filed in the US District Court for the Northern District of Texas on April 25, the Fairfield, NJ, company charged American Medical Electronics Inc. (AME) and its independent sales representatives with patent infringement and false representation of their product. AME, based in Dallas, TX, has answered the charges, and the case is now in discovery. EBI Vice President Richard Reisner told *Microwave News* that "signal specificity is key" to the effectiveness of the Bi-Osteogen system's non-invasive treatment of hard-to-heal fractures. He noted that, although it is possible that other signals might prove effective, EBI believes that the signal used in AME's Physio-Stim (for humans) and Thorough-Stim (for horses) units is the same as the Bi-Osteogen's. (There is no scientific consensus on how important signal characteristics are in achieving an effect.) Late last year, EBI concluded a successful defense against patent infringement claims from a subsidiary of Canada's Inco Ltd. (see *MWN*, December 1983).

MEASUREMENT

Magnetic Fields from Household Appliances... The IIT Research Institute (IITRI) of Chicago, IL, has completed the most detailed survey to date of magnetic fields from household appliances. Worst case measurements on 100 different appliances of 25 basic types by IITRI's J.R. Gauger found that 95 percent of the maximum magnetic fields at a distance of 1 foot (ft) were below 100 milligauss (mG) and below 1 mG at 5 ft. The maximum value at 5 ft was 4.7 mG. Small appliances with light motors in lightweight casings produced stronger fields than large appliances where the motor is often well shielded. For example, the maximum reading 1 ft from a can opener was 270 mG, dropping to 1.9 mG at 5 ft, while the maximum readings for a dishwasher were 26 mG and 0.7 mG at 1 and 5 ft respectively. The measurements were taken at 60 Hz. One electric shaver, however, generated its primary field at 120 Hz, and a television without a power transformer produced a 58 Hz field, the vertical sweep frequency. Background levels in the homes where the measurements were taken ranged from 0.5 to 1 mG. (The Earth's natural magnetic field, which is essentially static, is approximately 0.5 G, or 500 mG.) *Household Appliance Magnetic Field Survey,* Technical Report E06549-3, March 1984, was prepared for the US Naval Electronic Systems Command, Washington, DC 20360.

Resources...NBS has published *Electrical Parameters in 60 Hz Biological Exposure Systems and Their Measurement: A Primer,* Technical Note 1191, by M. Misakian. It is available from the Government Printing Office, Washington, DC 20402 for $2.25 (prepaid). Order No. 003-003-02581-1....Georgia Tech's Dr. Glenn Smith has published an article on "Limitations on the Size of Miniature Electric Field Probes," in the June *IEEE Transactions on Microwave Theory and Techniques*.... And a Canadian group headed by Health and Welfare's Maria Stuchly has written a paper on the performance characteristics of implantable E-field probes, which appears in the July *IEEE Transactions on Biomedical Engineering*.

MEETINGS

Hazard Assessment Symposium...EPA is sponsoring a *Symposium on Electromagnetic Field Measurements for Hazard Assessment* on October 10-12 at the Hacienda Resort Hotel and Casino in Las Vegas, NV. In addition, there will be a one-day tutorial, *An Introduction to Non-Ionizing Radiation,* on October 9. Among the topics on the agenda are the limitations of available instrumentation, new broadband and narrowband meters and calibration techniques. For more information, contact: Sheri Marshall, Dynamac Corp., PO Box 2198, Kensington, MD 20895, (301) 468-2500.

DOE-EPRI-NYS Bioeffects Review... This year researchers working under grants from the New York State Power Line Project will join those with funding from DOE and EPRI, who are studying the biological effects of high voltage 60 Hz and DC transmission lines at the 1984 Contractors Review. The meeting will be held at the Sheraton Hotel in St. Louis, MO, November 5-7. A block of rooms has been set aside for participants, and a special rate is available if you mention "DOE" to the reservations operator. Summaries of all the projects will be available two weeks before the meeting. If you are planning to attend or want a copy of the summaries, contact Dr. William Wisecup before September 1, Aerospace Corp., Suite 4000, 955 L'Enfant Plaza, SW, Washington, DC 20024, (202) 488-6328.

MILITARY SYSTEMS

EMP System on Chesapeake Bay... The Navy's plan to build a powerful Electromagnetic Pulse Radiation Environmental Simulator for Ships (EMPRESS II) on Maryland's Chesapeake Bay has met strong opposition from Governor Harry Hughes. In a July 13 response to an angry June 18 letter from Hughes, Secretary of the Navy John Lehman, Jr., promised to complete an environmental impact statement (EIS) before making a final decision on where to site the EMP generator. The Navy hopes to release a draft EIS in August. In order to test how well ship electronics would survive during a war, the EMPRESS II barge-mounted antenna would emit radiation similar to that released by a nuclear explosion. The EMP fields could reach 50 kV/m on ships approximately 100 meters from the proposed antenna. The inverted cone antenna will be 130 ft high by about 200 ft across the top. EG&G Washington Analytical Services Center recently won a $20.3 million contract to design and develop EMPRESS II, which is scheduled to begin operation in 1987. Meanwhile, the Navy is discontinuing use of EMPRESS I, a less powerful, land-based system located at Point Patience, Solomons, MD.

UPDATES

POWER LINES

State Actions...Florida...A $200,000 study of power line health and safety is getting underway in Florida to help the state's Department of Environmental Regulation evaluate the need for new rules. A five-member panel chaired by Professor H.B. Graves of Pennsylvania State University is scheduled to submit a report by January 1. The study is being funded by a consortium of Florida utilities: the state legislature mandated the investigation last year without providing necessary funding (see *MWN*, July/August 1983).

...Nevada...A June 1 federal court decision clearing the way for a ±500 kV power line through Henderson, NV, has been appealed. It all started when the town brought suit last year to move the line. Henderson argued that the environmental impact statement (EIS) for the 500-mile Intermountain Power Project line inadequately addressed health and safety issues and that the U.S. Department of Interior had overstepped its authority in granting route approval. Judge Leland Nielsen of the US District Court of Nevada found that the EIS was adequate, and more importantly, that local law could not take precedent over federal authority to grant right-of-way on federal land (Citizens for a Better Henderson v. James Watt, CV-LV 83-306, HEC). The appeal was filed June 22 in the US Ninth Circuit Court of Appeals in Las Vegas by the plaintiffs' attorney, Elizabeth Foley.

...Virginia...A joint subcommittee of the Virginia legislature set up to study power line health and safety issues (see *MWN*, June 1984) will hold its first hearing on August 9 in the town of Floyd. A second hearing for expert testimony will be held in Richmond in September or October. For information, contact Ms. Terry Mapp, Division of Legislative Services, Virginia Legislature, PO Box 3A-G, Richmond, VA 23208, (804) 786-3591.

VDTs

Regulations for VDT Radiation?... Federal regulation of VDT radiation emissions falls within the authority of the Radiation Control for Health and Safety Act of 1968, according to a legal note published in the November 1983 *Southern California Law Review* (Vol.57, No.1). Author Sheryl Gordon McCloud argues that the Act "enables [the Center for Devices and Radiological Health] to regulate a *risk* of injury," (emphasis McCloud's) and that such a risk exists with VDT radiation emissions. The note, *Pink Collar Blues: Potential Hazards of Video Display Terminal Radiation*, challenges federal policies which assume that available data on VDTs are conclusive. McCloud argues that, "In the face of [the uncertainty about possible hazards], government publications assure us that VDTs are safe and that current standards are adequate. This note seeks to discredit these conclusions and to undermine the complacency they engender." She advocates "that federal rulemakers and policy makers acknowledge that our knowledge of VDT hazards is incomplete, and that our current rules, policies and standards offer no guarantee of safety to workers." Single copies of the law review are available for $9.00 each from the Gould School of Law, The Law Center, University of Southern California, University Park, Los Angeles, CA 90089.

(continued on p.12)

CLASSIFIEDS

Microwave News reaches a select audience of specialists in non-ionizing radiation, and you can too. Advertise in *Microwave News* classifieds. Rates start at $50 for 1/32 of a page, $95 for 1/16 and $175 for 1/8. For information or to reserve space, call us at (212) 725-5252.

VDT Health and Safety

VDT News is *the* resource for reliable, up-to-date information on VDT health and safety. Coverage includes research, legislation and resources. Order today ($18/year for individuals [personal check required], $35/year for institutions.) Orders must be prepaid. Send to: *VDT News*, PO Box 1799, Grand Central Station, New York, NY 10163, (212) 725-5254.

VDTs 1983 Now Available

Video Display Terminals: 1983 Health and Safety Update is now available for only $7.50 prepaid. *VDTs: Health and Safety 1981-1982* is still only $6.95 prepaid. Order your copies from VDT News now.

Can You Afford Not to Subscribe to *Microwave News*?

Are you reading someone else's copy of *Microwave News*? Or are you breaking the law and reading a photocopy of *Microwave News*? STOP! Subscribe today.

Microwave News Research Service

To help our readers stay on top of legislative and regulatory developments, *Microwave News* now offers a research service. For a small fee, our staff will obtain and send you copies of legislation, regulations and other important documents. Resource areas covered include: powerlines, state exposure standards, government reports and VDT health and safety legislation.

The cost for this service is $0.25/page with a minimum of $3.50 per document, plus postage. Rush orders cost $0.40/page with a minimum of $7.50 a document. We also will do in-depth research for you at $20.00 an hour.

For a list of available materials or for more information, write *Microwave News Research Services*, PO Box 1799, Grand Central Station, New York, NY 10163, or call (212) 725-5252.

EPA Options Paper on RF/MW Guidance

As we reported in our June issue, the Environmental Protection Agency's (EPA) proposed guidance for public exposure to radiofrequency and microwave (RF/MW) radiation has met stiff opposition within the agency and may be scrapped. It is now known that the objections are coming from EPA's Office of Policy Planning and Evaluation (OPPE). On May 11, shortly after the draft guidance was submitted for internal agency review prior to publication in the Federal Register, *Deputy Assistant Administrator Jack Campbell of OPPE circulated an options paper recommending that EPA take no regulatory action on RF/MW radiation. The Office of Radiation Programs (ORP), apparently surprised by OPPE's stance, is now lobbying to save the guidance it spent five years developing. Agency officials have remained unusually tight-lipped about the ongoing struggle, and will only say that a decision is expected by fall.*

The full text of Campbell's options paper is printed below. The paper was addressed to Assistant Administrators Joseph Cannon, Office of Air and Radiation, and Bernard Goldstein, Office of Research and Development (ORD).

Options for Addressing Potentially Adverse Health Effects from Public Exposure to Radiofrequency Radiation

ORP'S PROPOSAL

ORP is recommending that EPA use its Federal Radiation Council Authority to propose guidance which would limit public exposure to radiofrequency (RF) radiation. More specifically, ORP's proposal would provide federal guidance that RF exposure to the public should be limited to a whole-body *Specific Absorption Rate* (SAR) equal to or less than 0.04 Watts per kilogram (W/Kg).

ISSUES FOR RESOLUTION

The primary issues requiring resolution are as follows:

1. Should EPA propose guidance?
2. If guidance is to be proposed, what SAR value is appropriate?

BACKGROUND

There are no federal standards/guidelines for controlling exposure of the *general public* to RF radiation in the environment at this time. (But there are FDA standards for microwave ovens, OSHA recommendations for limits on occupational exposures and a voluntary "standard" for occupational exposure developed by the American National Standards Institute (ANSI).)

There is no statutory requirement to promulgate RF limits, but the agency has been requested to prepare guidance by various federal (FCC, NTIA), state and local agencies and private sector groups. Public comments to a December 1982 ANPRM [advanced notice of proposed rule making] strongly supported the development of RF guidance.

ORP believes guidance is needed to: (1) Limit the potential public health consequences of increasing and continuous exposure to RF radiation in the general environment, and (2) Provide a sound basis for (hopefully) uniform state and local standards. Final *promulgation of Federal Radiation Guidance requires the President's signature*. Guidance would not be "enforced" by EPA; each federal agency would be separately responsible for implementing and complying with the guidance, e.g., the FCC is granting or renewing radio licenses.

Important RF sources include such facilities as AM and FM radio stations, television, radar, satellite communication and microwave relay systems, land mobile radio and amateur radio.

Biological Effects

Biological effects are related to the rate at which RF energy is absorbed by an individual. This "dose rate" is usually expressed as watts per kilogram of body mass (W/Kg) and is termed the *Specific Absorption Rate* (SAR). The available information on biological effects of RF radiation have been critically reviewed and summarized in [an] extensive report prepared by ORD; the report has been reviewed and approved by the [Science Advisory Board] (SAB) for the purpose of standard-setting, although the SAB offered no guidance in where the standard should be set.

A very wide range of biological effects has been observed in experimental animals:

- At levels *far* in excess of that found in the general environment, short-term whole-body exposure to RF radiation can be lethal (typically for SAR > 30 W/Kg). Brief exposure to similarly high RF levels in experimental animals has been shown to lead to birth defects, increased resorptions, lower birth weight and reduced survival rates in general.
- At somewhat lower SAR levels of 4-30 W/Kg (but still far above levels found in the general environment), generally observed effects in experimental animals include decreased birth weight, reduced fertility, and various immunologic, hematologic and hormonal effects. Changes in animal behavior have also been observed. (In some experiments, a SAR in the range 4-6 W/Kg has been found to be lethal to rats, dogs and rabbits.)
- At SAR levels *beginning to approach* those that may be formed in this general environment (somewhat less than 4 W/Kg), the public health significance of the observed biological effects are still controversial. Preliminary findings include various neurological, metabolic and histologic changes in animal tissue and cells *in vitro*; behavioral changes in animals exposed under conditions of high ambient temperature and humidity; and some *tentative indication* that RF radiation may act in some cases as a cancer promoter or co-carcinogen in animals at a whole-body SAR of 2-3 W/Kg.

In regard to the Specific Absorption Rate, the ORD report's Summary and Conclusions Section finds that "the data currently available on the relation of SAR to biological effect show evidence for biological effects at an SAR level of about 1 W/Kg. This value is lower by a factor of 4 than 4 W/Kg, the value above which reliable evidence of hazardous effects was found by ANSI (1982) following a review of the literature in February 1979." With respect to body ("core") temperatures, the review's Summary finds that "exposure of human beings at frequencies in the resonant region at an SAR of approximately 1 W/Kg produces significant changes in body temperature under some environmental conditions."

The report thus concludes that the "review of the currently available literature on RF radiation provides evidence that biological effects occur at an SAR of about 1 W/Kg; some of them may be significant under certain environmental conditions."

Public Exposure Data

Over the last decade, ORP has made fairly extensive measurements of RF radiation in the general environment. These measurements were generally made in terms of power densities (rather than SARs) expressed in terms of microwatts per square centimeter (uW/cm^2). Even in urban areas, where RF radiation levels are generally much higher than in rural regions, *very few (if any) individuals in the general public are currently exposed to a SAR of 1 W/Kg.*

ORP studies found that in 15 major U.S. cities 99.4 percent of the population were exposed to power densities < 1 uW/cm^2 in the primary frequency range of interest (equivalent to a SAR of < 0.0004 W/Kg at resonance). About 0.3 percent of the population was found to be exposed to power densities from 1-to-2 uW/cm^2; 0.07 percent from 5-to-10 uW/cm^2 and 0.02 percent from 10-20 uW/cm^2. (For reference, a 20 uW/cm^2 exposure is equivalent to a SAR of about 0.008 W/Kg at resonance.) The median exposure was estimated to be 0.0048 uW/cm^2. Power densities in non-urban areas would typically be several factors of 10 lower. Thus, only a very small fraction of the population is exposed to RF levels that even approach those that are currently thought to be significant. The maximum level measured in urban ground-level locations commonly frequented by people was 10.9 uW/cm^2 (equivalent to SAR of about 0.004 W/Kg (at resonance)).

Sources likely to produce the most significant population exposure levels are FM radio and VHF television stations. *Field intensities generally decrease rapidly as one moves away from the broadcast tower.* Power densities from FM radio stations, for example, typically drop by a factor of 10 as one moves away from the base of the tower by a distance on the order of 150 feet. EPA measurements inside high buildings that are close to broadcast antennas have found power densities up to about 100 uW/cm^2 (or about 0.04 W/Kg at resonance). In special circumstances, EPA measurements at locations containing multiple-towers and/or multiple-antennas in very close proximity found power densities on public property of up to about 7,000 uW/cm^2 (or about 2.8 W/Kg at resonance). While often accessible to the general public, comparatively few people approach such locations and those people are typically there for only a brief period.

ORP's Rationale for the Proposed 0.04 W/Kg Standard

ORP is proposing to take this 1 W/Kg SAR value and reduce it to 0.04 W/Kg to derive RF guidance for the general public. (In the draft proposal, ORP actually starts with a SAR value of 4 W/Kg, a level at which biological effects are "obviously adverse," and reduces it to 0.04 W/Kg by using a safety factor of 100.)

The basis for ORP's proposal is as follows:

- The 4 W/Kg SAR "observed effects" level is based largely on animal data for short-duration exposures under non-stressful temperature and humidity conditions. (At higher temperature and humidity conditions, effects should occur at lower SARs.)
- There is currently little information on long-term effects in animals or humans.
- There are considerable differences in human susceptibility to thermal stress. Young children and older individuals are especially sensitive.
- Some biological effects are known to occur below 4 W/Kg.
- The SAR within specific parts of the body can exceed the whole-body average SAR value by as much as a factor of 100.
- For *occupational* exposures, the "safety factor" selected by the American National Standards Institute for its voluntary standard was 10. (For ionizing radiation, an additional factor of 10 is used to go from an occupational to a general population standard. A similar choice for RF radiation would result in an overall safety factor of 100.)
- Ambient temperature and humidity conditions in the general environment may be such as to impose thermal stress even ignoring the additional thermal stress potentially associated with RF radiation.
- Mathematical simulations suggest a 2.3 W/Kg SAR should lead to a 1 degree C increase in human ("core") temperature. (Occupational standards recommend that workers should not be permitted to continue their work when their temperature rises by 1 degree C.) A 1 W/Kg SAR is estimated to increase core temperature by about 0.5 degree C.
- Economic impacts do not appear to be especially sensitive to the safety factor of 100. (More on this shortly.)

OPPE Position

OPPE recommends Option 1 [see below] which provides for the dissemination of all available health information to the public, FCC and others interested in this issue. OPPE does not believe available data indicate a need for EPA regulation, because:

- There are only a few facilities (if any) exposing individuals to RF radiation at levels where adverse effects have been observed in animal studies.
- Studies did not show effects thought to be adverse until the SAR was > 1 W/Kg, while it is true that most animal studies were short in duration and didn't account for higher temperature or humidity. This is several orders of magnitude above typical exposure levels.
- We have no basis to assume that long-term biological changes will be adverse to human health. This kind of uncertainty is common among EPA's health related actions.
- It is probably true (although we don't have epidemiological data that children and the elderly are more sensitive to RF radiation but the number of exposed people must be remembered: 99.4 percent of the urban population and (presumably) essentially 100 percent of the rural population are exposed to less than 0.0004 W/Kg. (The remainder of the urban population is thought to be generally exposed to less than 0.008 W/Kg.)
- It is true that biological effects are known to take place below 4 W/Kg but *it is not established that these are adverse to human health.*
- The safety factor of 10 chosen by ANSI is arbitrary; the safety factor of 100 proposed by ORP is equally so; *both are well below the observed health effects level.*
- While it is possible that ambient weather conditions could exacerbate RF health effects, this possibility has *not* been studied in detail sufficient enough to be used for guidance (at the RF radiation levels normally found in the general environment).
- It is true that the cost to society of this standard is not enormous. However given the remote probability that someone would die of ambient RF exposures, the *cost per life saved of this standard is infinite.*
- The 0.04 W/Kg standard is inconsistent with the risk management decisions EPA has made in: (a) benzene (NESHAP) (b) arsenic (NESHAP) (c) asbestos (Section 5 TSCA) (d) EDB (e) SO2 (NAAQS) (f) PM (NAAQS).
- It has been suggested that an EPA standard will give the public assurance that they are safe from RF. If this is true, exposures above the standard would probably be perceived as dangerous (even though perhaps below the observed effects level). We have no assurance that states won't automatically regulate below *any* EPA standard.

Compliance Measures

At broadcast stations where guidance is exceeded, ORP suggests there are generally several alternative ways to achieve compliance. Depending on circumstances, these may include:

- Post area over guideline;

- Replace existing antenna with a more efficient design with standard 1-wavelength spacing;
- Replace existing antenna with 1/2-wavelength spacing;
- Lease on taller existing tower;
- Build new tower on an existing site;
- Build a tower on a new site; and
- Prohibit public access.

Economic Impacts

For commercial *broadcast* stations, preliminary estimates indicate that the exposure limit of 0.04 W/Kg ORP is recommending would have an estimated net total present value cost of about $22 to $52 million (1983$). Actual expenditures would be expected to be spread over a six year period. Mid-range cost estimates and the estimated number of affected facilities for various SAR levels are as follows:

SAR	Economic Impacts[1]	Number of Stations Potentially Affected[1]
4.0 W/Kg	$11 million	178
1.0 W/Kg	$12 million	456
0.4 W/Kg	$15 million	1122
0.08 W/Kg	$28 million	1745
0.04 W/Kg	$39 million	3361

[1]ORP staff state that these are "worst-case upper-limit" estimates and indicate that further analysis will substantially reduce both the cost estimates and the potential number of stations affected.

These estimates are currently being revised, but ORP staff believe the costs are not expected to change markedly. ORP is currently surveying FM radio stations to determine actual land use in the immediate vicinity of the transmitting towers. Results are not expected for some months, but ORP staff expect this information may lead them to reduce cost estimates significantly.

Non-broadcast sources (e.g., radars and satellite communication systems) were also studied. Theoretically calculated field intensities were estimated. The number of government installations affected by the guidance was found to be a few percent of the total number of installations. No cost analyses were performed for these sources, however, because of the lack of cost data for much of the military equipment and the great diversity of site parameters.

OPTIONS

Given the above information, several options seem worthy of consideration from OPPE's standpoint. ORP recommends Option 5.

1. Distribute Information to the Public.

Take no regulatory action but distribute health data to the public, noting that people are safe given expected exposure rates. Continue research if necessary.

a. Pro: (1) Avoids unwarranted fears that could result from setting a stringent standard. (2) Gives states, cities and the FCC assurance that people are not at risk. (3) Avoids inconsistency with ANSI (occupational) standard. (4) Avoids the need to make a sweeping risk management decision which might result in economic impacts that go beyond what can be currently estimated. (5) Avoids unnecessary expenditures of society's resources. (6) Exposures to RF radiation which may result in adverse health effects could still be addressed by FCC and others using EPA health data.

b. Con: (1) Could be perceived as unresponsive to state, FCC and industry requests for a standard. (2) Would offer no protection.

2. Take No Action at This Time.

Since EPA is not required by statute to propose RF guidance, taking no action at this time would permit ongoing biological, technical and economic analysis to be further refined.

a. Pro: (1) Since the general population is presently under little, if any, risk from RF radiation, an extended delay to permit further advances in the bioeffects research makes it possible to substantially improve the guidance when issued within the next few years. (2) In principle, RF guidance developed after a delay significant enough to permit a substantial increase in our knowledge base should be better able to protect the public with less chance for economically burdensome impacts due to an overly protective standard. (3) Consistent with current understanding of effects at known exposure levels over short periods of time.

b. Con: (1) Not responsive to federal, state and local requests for RF guidance. (2) More (non-uniform) state and local standards could be established and these could impose a greater cost to society than Options 3-5. (3) Some additional installations of new RF sources could be stopped or delayed by undue public concern over RF radiation.

3. Base Proposed Guidance on a SAR of 1.0 W/Kg.

ORP's draft would be revised to conform to a maximum SAR of 1.0 W/Kg.

a. Pro: (1) A SAR of 1.0 W/Kg is the level at which the bioeffects document identifies as producing potentially significant biological effects. (2) Low estimated cost to society ($12 million, spread over six years). (3) Substantially lower than existing (but dated) OSHA guidance for occupational exposure based on a maximum SAR of 4.0 W/Kg. (4) Some states and cities are likely to establish standards more stringent than EPA guidance. As a result, guidance of even 1.0 W/Kg may be translated into much lower levels. (5) Small exposed populations (essentially zero).

b. Con: (1) Higher than recent occupational guidance recommended by ANSI (0.4 W/Kg). (2) Inconsistent with the current *draft* recommendations being prepared by the National Council for Radiation Protection and Measurement (NCRP) which recommends a maximum SAR equivalent to 0.08 W/Kg. [NCRP is a non-profit corporation chartered by Congress that collects, analyzes, develops and disseminates information and recommendations about radiation protection and radiation measurements, quantities and units.] (3) A 1.0 W/Kg SAR limit could lead to an estimated human "core" temperature increase of about 0.5 degree C; this increase could be significant under certain ambient heat and humidity conditions, especially for certain sensitive populations exposed to continuous doses for extended periods of time.

4. Base Proposal on a SAR of 0.4 W/Kg.

ORP's proposed guidance would be revised to conform to a SAR of 0.4 W/Kg.

a. Pro: (1) Relatively small cost to society ($15 million, spread over six years). (2) In theory, fewer people would be exposed to higher SAR values since exposures between 0.4 and 1 W/Kg would be inconsistent with the guidance. (But since the number of people receiving an average SAR in this range is extremely small, the actual significance is uncertain.) (3) Below the level at which there are known adverse health effects in animals. (4) Consistent with ANSI's occupational guidance.

b. Con: (1) Could indicate to the public that levels above 0.4 W/Kg are dangerous whereas data indicate otherwise. (2) Inconsistent with other EPA actions in that it is below the no observable health effects level. (3) Could be perceived as inadequate because it permits public exposures at a level equal to the generally accepted occupational guidance by ANSI. (4) Could lead to heat stress for some temperatures and humidity conditions for *some* population groups (the young, the aged and those with cardiovascular disease), if these individuals remain within 100-200 feet of the facility for a continuous period of time. (5) No certainty that states and cities will adopt it; they could adopt a more stringent standard.

5. Base Proposed Guidance on a SAR of 0.04 W/Kg.

(ORP's proposal)

a. Pro: (1) Strongly protective of public health in relation to Options 1-4 above. (2) Consistent with the usual practice of generally providing substantially more protective standards for the general public than those established for occupational exposures. (3) A 0.04 W/Kg SAR limit should protect against any thermally-related health effects in all human populations even under *adverse* temperature and humidity conditions, based on available data. It would result in a maximum estimated 2-to-4 percent increase over the basal metabolic rate.

b. Con: (1) Relatively high cost to society ($39 million, spread over six years). (2) No known health benefit for costs incurred in setting a standard below 1 W/Kg. (3) Seems inconsistent with recent agency decisions in that it is well below the known observable health effects level. (4) No certainty that states and cities will adopt it; they could adopt more stringent standards.

UPDATES *(continued from p.8)*

Legislation... The California Assembly defeated bill number 3175 by 37-25, after the Ways and Means Committee approved the measure by a narrow margin. The committee-passed version was markedly different from the bill originally introduced by Assemblyman Tom Hayden (see *MWN*, May 1984). The amended bill, though weakened in many respects, still would have required employers either to shield terminals to block non-ionizing radiation emissions or to provide alternative work during pregnancy for operators; the bill also would have established a task force to determine how to protect VDT workers. Following the Assembly's vote, Hayden asked that the bill be sent back to the Labor Committee for further hearings. This motion was approved and new hearings are expected in the fall....In Connecticut, state officials, computer manufacturers and labor groups have agreed to form a VDT study task force, following the completion of a study required by a 1983 law (see *MWN*, June 1983). No meetings have been held yet, and no agenda has been prepared....Massachusetts legislators have added $75,000 to the state's fiscal 1985 budget for a VDT health and safety study. Originally advocated by Representative Elizabeth Metayer as an amendment in the House of Representatives, the money will be used by the Department of Labor and Industries' division of occupational hygiene to "evaluate virtually every aspect of VDT work," according to a legislative staffer. The budget officially took effect on July 1, but no timetable has been set for the study....Representative Karen Clark introduced Minnesota's first VDT legislation earlier this year, but no action was taken on the measure. Bill number H.F. 2333 would have required employers to provide adjustable furniture and terminals, glare reduction procedures and annual eye examinations. Semiannual testing for radiation emissions "above allowable standards" and alternative work during pregnancy also were included in the legislation.

CONFERENCES

September 10-13: **4th International Conference on Dielectric Materials, Measurements and Applications,** University of Lancaster, England. Contact: Institution of Electrical Engineers, Savoy Place, London WC2R OBL, England, (01) 240-1871, ext. 222.

September 10-13: **14th European Microwave Conference,** Liege, Belgium. Contact: Microwave Exhibitions & Publishers, Convex House, 43 Dudley Rd., Tunbridge Wells, Kent TN1 1LE, England.

September 17-19: **19th Annual Microwave Power Symposium,** Minneapolis Plaza Hotel, Minneapolis, MN. Contact: IMPI, Suite 520, 301 Maple Ave. West, Vienna, VA 22180, (703) 281-1515.

September 17-19: **37th Annual Conference on Engineering in Medicine and Biology,** Los Angeles Hilton, Los Angeles, CA. Contact: Patricia Horner, Alliance for Engineering in Medicine and Biology, Suite 402, 4405 East-West Hwy., Bethesda, MD 20814, (301) 657-4142. The **6th Annual Conference of the IEEE-Engineering in Medicine and Biology Society** will meet September 15-17 immediately before the ACEMB meeting.

September 17-21: **NATO Advanced Research Workshop on Interactions Between Electromagnetic Fields and Cells,** Erice, Italy. Contact: Professor A. Chiabrera, Biophysical and Electronic Engineering Dept., Via all'Opera Pia 11A, 16145 Genoa, Italy, (10) 311811.

September 18-21: **4th International Conference on Electromagnetic Compatibility,** University of Surrey, Guildford, England. Contact: Institution of Electronic and Radio Engineers, 99 Gower St., London WC1E 6AZ, England, (01) 388-3071.

September 26-28: **International Symposium on Electrostatics —Applications & Hazards,** Polygon Hotel, Southampton, England. Contact: Helen Raquet, Oyez Scientific and Technical Services, Bath House, 56 Holborn Viaduct, London EC1A 2EX, England, (01) 236-4080.

October 2-4: **Interaction of Biological Systems with Static and ELF Electric and Magnetic Fields,** Holiday Inn, Richland, WA. Contact: Patricia Bresina, Battelle Pacific NW Labs, PO Box 999, Richland, WA 99352, (509) 376-0100.

October 2-4: **6th Annual Electrical Overstress/Electrostatic Discharge Symposium,** Marriott Hotel, Philadelphia, PA. Contact: EOS/ESD Symposium, PO Box 9172, Fort Collins, CO 80525, (303) 221-8059.

October 10-12: **Symposium on Electromagnetic Field Measurements for Hazard Assessment,** Hacienda Resort Hotel and Casino, Las Vegas, NV. Contact: Sheri Marshall, Dynamac Corp. PO Box 2198, Kensington, MD 20895, (301) 468-2500.

October 16-18: **1984 International Symposium on Electromagnetic Compatibility,** Tokyo, Japan. Contact: Professor T. Takagi, Dept. of Communications, Tohoku University, Sendai, 980, Japan, (0222) 22-1800, ext. 4266.

MICRO WAVE NEWS

Vol.V No.6 A Report on Non-Ionizing Radiation July/August 1985

INSIDE...

HIGHLIGHTS pp.2-7

NIOSH Proposes RF/MW Occupational Standard Stricter than ANSI's

ELF and Cancer: More Studies

Symposium on Electropollution and Brain Tumors

Portland, Oregon Again Proposes 100 uW/cm² Standard

Hawaii Broadcast Towers Blamed for Burns and Extensive EMI

Florida Panel Discounts Power Lines Bioeffects

EXCERPTS pp. 8-9

NIOSH Draft Recommended Occupational RF/MW Exposure Standard

UPDATES pp.10-15

Diathermy and Low Back Pain ▫ Honeybees and Power Lines ▫ Woodpecker Watch ▫ Immunology in the U.S.S.R. ▫ Power Line Contractors Meeting ▫ FCC Enforcement Actions ▫ Finnish RF Standard ▫ Planning a Power Line ▫ Congressional Research Proposals ▫ Effects of Safety Standards on the Military ▫ FCC Reaffirms Cable Leakage Rules ▫ HF System in Massachusetts ▫ NBS on Estimating Complex Fields ▫ Yannon Hearing ▫ Aircraft EMI ▫ More on SCEs and Ultrasound ▫ VDT Settlement ▫ Change at ACGIH ▫ Bioeffects Bibliographies ▫ Loesch Claim ▫ Cellular Phones: Promises and Reality ▫ C63 Ballots ▫ 1986 Gordon Conference ▫ Manipulating Genes ▫ EMI Survey ▫ and more...

Editor's Note p.3

Conferences p.7

RF and VLF Radiation Hazards Reappraised

The health risks associated with exposure to 30-70 MHz radiofrequency (RF) radiation are greater than previously believed, according to Professor Om Gandhi of the University of Utah. This new finding, together with previous research on shocks and burns from very low frequency (VLF) fields (300 kHz-3 MHz), could force a reappraisal of the adequacy of current safety standards, possibly leading to changes in the operation of broadcast transmitters and of industrial machinery such as RF sealers and heaters.

Gandhi has found that a 1 mW/cm² 40 MHz field induces a maximum current of 780 milliamps (mA) through the ankles in a free standing adult. Gandhi estimates that the resulting local specific absorption rate (SAR) in the ankles is 243 watts per kilogram (W/Kg). Such "hot spots" may present a risk of burns and other internal injuries.

Present exposure standards seek to limit *whole-body* SARs — for instance, the 1982 American National Standards Institute (ANSI) guidelines are keyed to a maximum SAR of 0.4 W/Kg. The ANSI standard also has a clause that specifies a maximum partial-body exposure of 8 W/Kg. The National Institute for Occupational Safety and Health (NIOSH) has recently proposed a similar partial-body limit of 5 W/Kg (see story on p.2). Gandhi has thus measured levels that are nearly 50 times greater than NIOSH's proposed local SAR limit.

Gandhi has also calculated the SARs for children in a radiation field. For a 10-year-old child standing in a 1 mW/cm² field, the maximum local SAR is 371 W/Kg at 50.7 MHz. A 5-year-old child experiences a maximum local SAR of 534 W/Kg at 62.5 MHz.

In a telephone interview, Gandhi said that the fields cause "very large currents" to pass through the human body: "What we thought were very low fields can nevertheless induce currents with very large local SARs." Gandhi, who is with the Department of Electrical Engineering at the University of Utah in Salt Lake City, told *Microwave News* that, "We must understand the role such high currents play in the human body."

According to Gandhi, up to 85 percent of the current passing through the ankles is also flowing through the abdominal region. To put the numbers into perspective, he explained that, *without* cooling by blood flow, an SAR of 70 W/Kg can cause a 1 degree Centigrade rise in body temperature per minute.

Of course, increased blood flow does cool off heated tissue, but whether it can do so before any damage occurs and whether the body's thermoregulatory system can handle the increased heat load are still unresolved questions and in need of study.

Some of Gandhi's data appear in the June issue of the *Proceedings of the IEEE, 73,* 1145-1147. The paper was submitted more than a year ago, and some of the results have now been revised with higher SARs than were originally reported.

(continued on p.9)

HIGHLIGHTS

NIOSH Proposes RF/MW Occupational Standard – Stricter Than ANSI's

The National Institute for Occupational Safety and Health (NIOSH) has proposed worker exposure standards that are, for many frequencies, twice as strict as those set by the American National Standards Institute (ANSI) in 1982. The NIOSH proposal is part of a 293-page draft criteria document on occupational exposures to radiofrequency and microwave (RF/MW) radiation, released at the Bioelectromagnetics Society (BEMS) meeting held in San Francisco, CA, in mid-June.

In the external review draft of the criteria document, NIOSH proposes to limit worker exposures to a maximum of 0.5 mW/cm^2 for the 30-300 MHz frequency range. For 300 kHz-3 MHz, the maximum exposure would be 50 mW/cm^2. Like the ANSI standard, NIOSH proposes adopting a "ramp" type, frequency-dependent standard. Above 3 GHz, the NIOSH proposal would be 5 mW/cm^2, identical to ANSI's. (Excerpts from the NIOSH recommended exposure standard appear on pp.8-9.)

NIOSH is now in the process of soliciting comments on the draft criteria document from experts inside and outside the federal government. A revised draft will then be reviewed by Dr. Donald Millar, director of NIOSH. If approved, the final document should be issued next year.

The completed NIOSH document will be forwarded to the Occupational Safety and Health Administration (OSHA), which could set a standard for workplace exposures — though at present OSHA has no plans to do so (see *MWN*, November 1983 and March 1984).

Such a standard could affect a large number of workers. According to a report prepared for OSHA in 1982 by Centaur Associates, nearly nine million Americans are exposed to non-ionizing radiation on the job.

Basis for the Standard

The NIOSH standard is based on a threshold for adverse bioeffects at a specific absorption rate (SAR) of approximately 2 W/Kg. Using a safety factor of 10, NIOSH recommends that average whole-body SARs be limited to 0.2 W/Kg. In comparison, the ANSI standard is keyed to an average SAR of 0.4 W/Kg.

According to NIOSH, "No measurable core temperature increases are expected to occur in man or animals at SARs of 0.2 W/Kg or less. Few substantiated biological changes of any type have been reported in animals at SARs lower than 0.2 W/Kg, and the changes that occurred were not judged by NIOSH to have any significant effect on the health of the animal. SARs below 0.2 W/Kg are thus not expected to have any significant effect on man....The 0.2 W/Kg limit should prevent any additional increase in body temperature due to RF exposure, regardless of the ambient conditions."

In a paper presented at the BEMS meeting, "Assessment of the Biological Effects of RF Radiation," NIOSH's Dr. Joseph Lary, Dr. David Conover and William Murray summarized the basis for the NIOSH recommendations:

> Several adverse effects have been reported at SARs between 1.8 and 4.5 W/Kg including death (rats and rabbits); rectal temperature increases exceeding 3 degrees C (monkeys, dogs); hemorrhagic lesions, other tissue lesions, and tubular nephrosis (rabbits); staggering, muscular flaccidity and collapse, and spasms of the legs and wings (chicks); and extreme agitation, impaired locomotion, and exhaustion (dogs). At SARs exceeding 4.5 W/Kg, prolonged exposure generally produced severe hyperthermia in most animals and caused a variety of adverse health effects. At SARs below 1.8 W/Kg, no biological effects were reported which were considered by the authors to be clearly adverse to the animals' health. However, in the SAR range of 0.17-1.8 W/Kg, measurable increases in body temperature were reported as well as several distinctive physiological and behavioral changes. At SARs below 0.17 W/Kg, no temperature increases were reported and most of the biological effects involved increases in calcium efflux from the brain or increased permeability of the blood-brain barrier.

With respect to the calcium efflux effect, the NIOSH staffers argued that it "has no known significance to the health of the animal." As to the possibility of microwave-induced leakage through the blood-brain barrier, they concluded that this effect "has been difficult to replicate at low exposure levels and may be an experimental artifact."

The 0.2 W/Kg exposure limit should protect against any "significant interactions between RF radiation and drugs or chemical substances to which the worker might be exposed," according to the draft document. Of special concern, NIOSH cited the finding that RF/MW radiation can enhance the carcinogenicity of benzopyrene in mice at SARs as low as 2.0 W/Kg.

In the criteria document, NIOSH explains the need for the safety factor of ten partly because of uncertainty over heating effects in humans and rhesus monkeys — the agency notes that no significant temperature rise occurs in animals at SARs below 0.17 W/Kg — and partly because theoretical models indicate that the human thermoregulatory system is not affected at levels below 0.2 W/Kg. In addition, NIOSH cites the fact that "little is known about the long-term effects of chronic exposure of workers to RF radiation" and that, "The epidemiology literature presently does not provide an adequate basis to determine the long-term human health effects, if any, from exposure to RF radiation."

Under the NIOSH proposal, average whole-body exposures can exceed 0.2 W/Kg if partial-body exposures are not over 5 W/Kg — averaged over any one gram of tissue. The 1982 ANSI standard has a similar exclusion clause but with a maximum peak SAR of 8 W/Kg.

NIOSH explains: "It thus appears that continuous lo-

calized exposure of even poorly perfused tissues at an SAR of 5 W/Kg will not result in a localized temperature increase of more than a few tenths of a degree Centigrade and will not damage the exposed tissue." This 5 W/Kg limit should protect the lens and the pituitary gland from localized RF power deposition, according to NIOSH.

RF Shocks and Burns

NIOSH is seeking to protect workers against shocks and burns, irrespective of the ambient field:

> Exposure conditions which will cause an involuntary response (startle reaction) due to an RF shock or current flow are not permitted from 300 kHz to 300 GHz. In addition, exposure conditions which will cause an RF burn are not permitted from 300 kHz to 300 GHz. These restrictions apply even if the exposure limits of this standard are not exceeded.

For frequencies below 3 MHz, NIOSH concludes that the 50 mW/cm^2 exposure limit will protect workers against shocks, burns or excessive SARs *if* there is no contact with a conducting object. When such a contact is made, however, the risks are much greater.

For instance, the NIOSH staffers cite estimates that a worker in a 3 MHz electric field at 50 mW/cm^2 who touches a grounded conductive object with his hand could experience an SAR of 16,625 W/Kg, a level which "would obviously cause an RF burn or a possible accident-causing startle reaction."

NIOSH does not propose controlling RF shock and burn risks by limiting ambient field strengths, however. Instead, the agency advocates that such hazards "are best prevented by implementing appropriate safety features on a source-by-source basis rather than by limiting the incident field." The use of insulated gloves, shoes and other protective clothing is suggested as a possible control strategy.

NIOSH's Consultants

In preparing the document, NIOSH staffers consulted the following experts: Dr. Ernest Albert, George Washington University Medical Center, on central nervous system effects; Drs. Virginia Bruce-Wolff and Don Justesen, VA Hospital, Kansas City, on behavioral effects; Dr. Russell Carpenter, Food and Drug Administration, on ocular effects; Dr. Om Gandhi, University of Utah, on dosimetry; Dr. Ronald Jensh, Thomas Jefferson Medical College, on reproductive effects; Dr. Robert Lebovitz, University of Texas Health Science Center, on auditory effects; Dr. Robert Liburdy, U.S. Air Force School of Aerospace Medicine, on hematologic/immunologic effects; Dr. Shin-Tsu Lu, University of Rochester, on cardiovascular effects; Dr. Sol Michaelson, University of Rochester, on pathophysiological effects; and Dr. Vernon Riley, Pacific Northwest Research Foundation, on neuroendocrine effects.

Editor's Note

Microwave News Goes Bimonthly

With this issue, *Microwave News* begins a new publication schedule in a new, expanded format. Each issue will now be 16 pages long, and we will now publish bimonthly, rather than 10 times a year. These two changes, taken together, will result in essentially the same amount of news coverage over the year, while allowing us to cut costs.

We are making these changes to forestall an increase in subscription price. We have not raised our prices for three years and are reluctant to do so now, even though our expenses have gone up substantially.

Microwave News enjoys a very high renewal rate and we thank you for your loyalty. We trust that the changes we are making now will not affect your reliance on the newsletter as the premier source of information in the field. We encourage subscribers who are adversely affected by this change to contact us.

□ □ □ □ □

If you count on us for all the news from the nonionizing radiation community, we urge you to tell your associates how valuable the newsletter is. If we expand our subscription base, we will be able to hold off future price increases.

If you are reading someone else's copy, please get your own. If the newsletter takes a long time to circulate around your office, consider taking out additional subscriptions. If you are reading a photocopy, you are *breaking the law* and you should definitely subscribe.

□ □ □ □ □

The September/October issue of *Microwave News* will be published about three weeks late. We will resume our regular publishing schedule with the November/December issue.

ELF and Cancer: An Update

The number of papers and letters on the suspected link between extremely low frequency (ELF) radiation and cancer continues to grow. Reported below are the latest developments. (See also *MWN*, October 1984 and May 1985.)

Neuroblastoma Risks

Drs. Margaret Spitz and Christine Johnson have found that the children of fathers exposed to electromagnetic fields on the job had a significantly increased risk of developing neuroblastoma, a malignant tumor of the central nervous system (a twofold elevated risk: odds ratio of 2.13). Males who reported themselves to be electronics workers had an even greater risk of fathering children with neuroblastoma — though the number of such cases was small, the odds ratio was 11.75.

The researchers conclude that, while there are "inherent problems" associated with the use of indirect measures of exposure and of occupational groupings, as well as the possible confounding problem of chemicals and heavy metals, "Even a suggestive association [between electromagnetic fields and] childhood cancer is disconcerting, and replication studies in other populations are warranted."

Spitz is at the M.D. Anderson Hospital and Tumor Institute at the University of Texas, and Johnson is at the University of Texas School of Public Health, both in Houston. Their paper, "Neuroblastoma and Paternal Occupation: A Case-Control Analysis," appears in the June 1985 issue of the *American Journal of Epidemiology, 121,* 924-929.

Leukemia in Canada

High voltage power line workers have a threefold increased risk of dying of leukemia, according to Dr. Geoffrey Howe of the National Cancer Institute of Canada in Toronto. This finding emerged from a broader study of cancer mortality in Canada by Howe and Dr. Joan Lindsay, an epidemiologist with Statistics Canada, also in Toronto (see their paper in the *Journal of the National Cancer Institute, 70,* 37-44).

In a telephone interview, Howe told *Microwave News* that while the increased risk to power line workers is statistically significant, the number of cases studied is small. He explained that his research is designed to generate hypotheses rather than to yield conclusions about specific types of occupational risks. He said that, given the observed increased risk to power linemen, "the time has come to do some definitive studies." Howe plans to submit a letter to *Lancet,* the British medical journal, on the power line-leukemia link.

Brain Tumors

In our October 1984 issue, we reported on results obtained by Dr. Ruey Lin and colleagues at the Maryland Department of Health and Mental Hygiene which suggest a link between exposure to electromagnetic fields and the development of brain tumors. Their paper has now been

Symposium on Electropollution and Brain Tumors

Nobel laureate Dr. Marshall Nirenberg will head the list of participants at a symposium on the *Biological Effects of Electropollution: Brain Tumors and Experimental Models* to be held September 9 at Howard University in Washington, DC.

Dr. Sisir Dutta of the university's Departments of Botany and Oncology and Dr. Richard Millis of the Departments of Neurology and Zoology are organizing the university-sponsored meeting.

Other participants include: Dr. Carl Blackman of the Environmental Protection Agency (EPA), Dr. Om Gandhi of the University of Utah, Dr. Eugene Goodman of the University of Wisconsin-Parkside, Dr. B.E. Hackley of the U.S. Army's Institute of Chemical Defense at Edgewood Arsenal in Maryland, Dr. Bruce Kleinstein of Information Ventures, Dr. Ruey Lin of the Maryland Department of Health and Mental Hygiene and Dr. Margaret Spitz of the M.D. Anderson Hospital and Tumor Institute at the University of Texas in Houston.

Dutta and Millis are inviting researchers in the field of radiofrequency and microwave radiation biology who want to participate in the afternoon session to submit a letter of inquiry or an abstract. According to Millis, there are still five open slots for speakers; those selected will receive funds for travel and accommodations.

Nirenberg, the chief of the Biochemical Genetics Laboratory at the National Heart, Lung and Blood Institute in Bethesda, MD, has developed an experimental model for the study of neuroblastoma and will discuss potential applications at the meeting.

Dr. Joe Elder of the EPA will be the luncheon speaker, addressing the public policy issues associated with electropollution.

The symposium is open to the public, but attendance is limited to about 60. Pre-registration is required, but there is no fee. The proceedings of the meeting will be published. The symposium will be held at the Howard University Inn, adjacent to the campus.

For more information, contact Dutta or Millis at Electropollution Symposium, PO Box 83, Howard University Administration Bldg., Washington, DC 20059, (202) 636-6933.

published: "Occupational Exposure to Electromagnetic Fields and the Occurrence of Brain Tumors" appears in the June issue of the *Journal of Occupational Medicine, 27,* 413-419.

In addition to their earlier findings, Lin and coworkers report that "the mean age at death was found to be significantly younger among cases in the presumed high [electromagnetic] exposure group."

Responses to Milham

Dr. Samuel Milham's April 6 letter to *Lancet* claiming support for the hypothesis that electromagnetic fields are carcinogenic (see *MWN,* May 1985) has generated a number of replies, which in turn have prompted comments.

Two letters, published in the May 11 issue of the journal, contend that the "Silent Keys" column in the American Radio Relay League's (ARRL) *QST* magazine, used by Milham as an index of recent deaths, is incomplete and that Milham had failed to control for the hazards of dust and fumes from soldering electronic components.

Harsher criticism came from ARRL's Committee on the Biological Effects of RF Energy, chaired by Raymond Wrangler, in a letter in the June 29 *Lancet.* The committee members argue that Milham's "hypothesis that electromagnetic fields are carcinogenic remains purely speculative" and that, "On the basis of the data we have seen, it cannot be assumed that participation in amateur radio activities increases the risk of leukemia." They are also critical of Milham's use of proportional mortality ratios (PMRs).

Then, in the July 13 issue, Dr. Michael Coleman of the ICRF Cancer Epidemiology and Clinical Trials Unit in Oxford, England, took the ARRL committee to task for its "inaccurate commentary" on Milham's original letter, including the discussion of PMRs. Coleman also explained that, even if the "Silent Keys" column omitted some cases, the impact on Milham's analysis would be minimal: "Milham's result could be wrong — but it is unlikely to be far wrong. Any bias toward preferential reporting of leukemia deaths...would have to be severe; Milham would need to have missed over 1,500 deaths, not one of them due to leukemia, for his result to be entirely due to such a bias."

In 1983, Coleman reported that he and coworker Janine Bell had found a statistically suggestive link between ELF and leukemia in a population of electrical workers in southeast England (see *MWN,* June 1983).

Epidemiology Handbook

Drs. Tim Aldrich and Clay Easterly of Oak Ridge National Laboratory have assembled a *Handbook of Epidemiologic Methods with Special Emphasis on ELF Fields,* a guide to the literature on ELF effects, focusing primarily on the possible link to cancer. Copies will be available soon at no cost. Write to the authors at the Health and Safety Research Division, Oak Ridge National Lab, Oak Ridge, TN 37831. Include a self-addressed mailing label.

Portland, Oregon Proposes 100 uW/cm² Standard – Again

The City of Portland's Bureau of Planning has reaffirmed its support for a general population exposure standard of 100 uW/cm² for 30-300 MHz radiation. A new proposal by the bureau calls for regulation of the siting and operation of all television and radio stations in Portland, the largest city in Oregon.

The new initiative, issued in July, is intended to clarify the existing regulatory framework, which the city planners found to be inconsistent and, sometimes, inequitable. If approved by the City Planning Commission and the City Council, the plan will require operators of all existing radio and television broadcasting facilities in the frequency band between 100 kHz and 300 GHz to register with the city. Those seeking to build new broadcasting stations will have to apply to the city and conduct radiation measurements around the proposed sites.

The Planning Commission held hearings on the bureau's proposal on July 23 and is expected to reach a decision by September. The City Council will not take final action before December.

Over the 100 kHz to 300 GHz range, the proposed Portland standard is ten times stricter than the 1982 American National Standards Institute (ANSI) standard. The planning bureau concluded that the ANSI limit "does not allow a sufficient margin of safety from known adverse impacts on living tissues."

Portland adopted a 100 uW/cm² interim standard in 1980 — the first public exposure standard in the United States. Although the rules were approved by the Planning Commission, they were never incorporated into the city's zoning rules by the City Council.

In September 1984, the City Council passed an ordinance placing a moratorium on new permits for radio and television facilities until July 1, 1985. In June, the council extended the moratorium until completion of its regulatory review or until January 1, 1986, whichever comes first. According to Steven Gerber, the principal author of the proposed regulations, the moratorium only applies to "major" sources — those with an effective radiated power of 500 or more watts. Thus point-to-point and mobile communications systems are exempt.

The planning bureau contends that its new recommendations "are intended to provide a consistent and knowable set of criteria for the operation and siting of RF broadcast facilities, while providing protection to the general population from RF emissions and the aesthetic impacts of significant broadcast facilities."

The situation in Portland is complicated by the fact that Multnomah County, in which Portland is situated, has its own radiofrequency and microwave radiation standard — 200 uW/cm² in the 30-300 MHz band. Originally, the county had proposed a 50 uW/cm² standard, but backed off in the face of opposition from local broadcasters (see *MWN,* July/August 1982). The city's new proposal is very similar to the county rules, but the exposure levels are

twice as strict. According to the bureau's report, the Portland measure "has been written specifically to be compatible with the Multnomah County regulations."

The Portland planners argue that their proposal will not have any adverse economic impacts. They state that "There is no evidence that the admittedly conservative 100 uW/cm^2 standard will cause any significant hardship on the broadcast industry here in Portland." In addition, they have found no firm evidence "to suggest a negative impact on property values from proximity to broadcast facilities."

The Bureau of Planning has issued a three-volume report, *Radiofrequency (RF) Regulatory Review Project*, consisting of a "Report and Recommendations to the Planning Commission," a "Background Document" and a "Technical Appendix."

In the process of preparing the report, the bureau set up an RF Task Force, consisting of citizens, industry representatives and medical and technical experts.

For more information, contact Steven Gerber, Bureau of Planning, City of Portland, Room 1058, 1120 SW Fifth Ave., Portland, OR 97204, (503) 796-7706.

Hawaii Broadcasts Blamed for Burns and Extensive EMI

Radiation from broadcast antennas in Honolulu, Hawaii, is being blamed for shocks, burns and numerous instances of electromagnetic interference (EMI) with electronic equipment in high-rise condominiums neighboring the radio tower.

A study commissioned by Honolulu Councilmember Marilyn Bornhorst and released in June found that AM radio (550 kHz-1.6 MHz) broadcasts are a potential source of injury and are disrupting telephone answering machines and radio and television reception.

Richard Melton, a consultant who surveyed the residents of three condominiums for Bornhorst, concluded that metal objects in the apartments pose a danger of shocks and burns, ranging from "mild to capable of causing injury." He warned that "The severity of some of these problems is alarming and indicates a continuing danger of injury."

In the report, Melton characterized the interference as a "significant nuisance to many residents" at the two buildings closest to the transmitters — 100-250 feet from Ala Wai tower, from which 3 AM stations broadcast. At the third building, which is about 350 feet from the tower, reports of EMI-type disturbances were less common. The survey also included a fourth building more than a mile from the tower to serve as a control.

Other types of interference included buzzing in the ears and music emanating from interior walls, air conditioners and gold teeth. Also, radio broadcasts were recorded onto tape and video recorders and telephone answering machines.

The May 27 *Honolulu Advertiser* reported that one resident of the Villa on Eaton Square, one of the buildings surveyed, had gone through four answering machines in the hope of finding one that does not pick up spurious radio signals. On occasion, she returned home to find that, instead of her phone messages, she had a one-hour tape of rock music. She also experienced EMI problems with her stereo, television and electronic organ.

Zoning Changes Recommended

Melton argued that "The survey results leave little doubt that the phenomena being reported are caused by radiofrequency radiation and give sufficient information to initiate changes in land use policies regarding broadcast towers."

Melton recommended that federal standards be set for siting radio and television transmitters to reduce both potential health risks and EMI and called for a retrospective health study of "as many persons as possible who have lived and/or worked for significant periods of time near sources of radiofrequency radiation." He also urged local, state and federal officials to form a task force "to work out a consensus solution to the existing radiofrequency radiation problems."

In releasing the survey results in early June, Bornhorst supported the report's recommendations. She said that the data provide "sufficient evidence" that Honolulu's zoning code should be changed to distance broadcast towers from areas where people live and work. Zoning rules currently prohibit siting transmitter towers on the hills surrounding the city, forcing broadcasters to place them in the city.

EPA-FCC Survey

In May 1984, Richard Tell of the Environmental Protection Agency (EPA) and Dr. Robert Cleveland of the Federal Communications Commission (FCC) measured levels as high as 306 mW/cm^2 next to the access-limiting fence at the Ala Wai tower. In a recreational area on the roof of the Villa on Eaton Square, they found AM levels greater than 24 mW/cm^2 (see *MWN*, January/February 1985).

In a press release accompanying Melton's report, Councilmember Bornhorst expressed alarm that the EPA-FCC measurements contrasted sharply with the agencies' press statements that residents near the tower are in no immediate danger. "How can they say that when they knew about the danger of burns, they know that there is an epidemic of birth defects in Vernon Township (another 'hot spot'), and they know of long-term studies that show it causes cancer in laboratory animals," she said.

For a copy of the report, *Survey of Phenomena Experienced by Residents Living Close to the Ala Wai Broadcasting Tower, Honolulu, Hawaii* (June 1985), contact: Councilmember Marilyn Bornhorst, City Council, Honolulu, HI 96813, (808) 523-4000.

Florida Panel Discounts Power Line Bioeffects

The Florida Electric and Magnetic Fields Science Advisory Commission (SAC) has concluded that "It is unlikely that human exposure to 60 Hz electric and magnetic fields can lead to public health problems." The one-year,

$200,000 study was funded by the Florida Electric Power Coordinating Group (FCG), a consortium of state electric utilities, for the Florida Department of Environmental Regulation (DER).

The only adverse environmental effects associated with 230-or-greater kV transmission lines are the potential for pacemaker interference and shocks to honeybees living in hives under the lines, according to the SAC report.

The panel noted that "Adverse public health effects of such fields have not yet been established," but that "Because of certain ambiguities in the currently available scientific information, further developments in the area should be monitored." However, the panel added: "Once an initial decision has been made in Florida that public health problems are unlikely, reopening the area for further consideration would not be justified unless a significant new body of experimental evidence becomes available."

The SAC also concluded that "there is not currently sufficient evidence to allow the scientifically based choice of a measure of exposure to electric and magnetic fields that could be used as the basis for a program of exposure control."

The 266-page report, *Biological Effects of 60-Hz Power Transmission Lines*, recommends that "Concerned parties ...should urge the Food and Drug Administration to revise pacemaker testing and performance criteria so as to include circumstances representative of transmission line induced currents and appliance leakage currents."

The panel called on state agencies and the electric utilities to inform beekeepers of potential risks to their bees and of ways to eliminate these risks — grounded chicken wire surrounding the hives is sufficient in most cases.

The SAC was formed by the FCG as an independent source of scientific expertise to the DER. The department had been charged with responsibility for assessing potential health hazards of transmission lines and, if necessary, for promulgating safety regulations, as a result of legislation passed in 1983 following siting disputes (see *MWN*, July/August 1983 and July/August 1984). Despite its apparent link to the utilities, the commission's report explains that the panel operated at "arm's length" from the utilities and that the DER is not bound by the SAC's recommendations.

The commission was chaired by Professor H.B. Graves of the Pennsylvania State University in University Park, who also chaired a study on the Navy's Project ELF, which similarly concluded that the ELF fields would be "unlikely" to pose a health or environmental problem (see *MWN*, May 1985).

Other SAC members were: Dr. T. Dan Bracken of Scientific Research and Consulting Services in Portland, OR; Dr. Jerry Griffin of the University of California in San Francisco, CA; Dr. John de Lorge of the Naval Aerospace Medical Research Lab in Pensacola, FL; Dr. M. Granger Morgan of Carnegie-Mellon University in Pittsburgh, PA; and Dr. Tom Tenforde of the Lawrence Berkeley Laboratory in Berkeley, CA.

For more information, contact the FCG's Ron Spika, 402 Reo St., Suite 214, Tampa, FL 33609, (813) 877-5301. The report is available from the National Technical Information Service (NTIS), Springfield, VA 22161, (703) 487-4650.

CONFERENCES

September 9: **Biological Effects of Electropollution: Brain Tumors and Experimental Models,** Howard University Inn, Washington, DC. Contact: Electropollution Symposium, PO Box 83, Howard University Administration Bldg., Washington, DC 20059, (202) 636-6933.

September 9-12: **15th European Microwave Conference,** Paris, France. Contact: Microwave Exhibitions & Publishers Ltd., Convex House, 43 Dudley Rd., Tunbridge Wells, Kent TN1 1LE, UK.

September 10-12: **7th Annual Electrical Overstress/Electrostatic Discharge Symposium,** Radisson South Hotel, Minneapolis, MN. Contact: Michael Martin, 3M/Static Control Div., 2111 W. Braker Lane, Bldg. 501, PO Box 2963, Austin, TX 78769, (512) 834-3117.

September 12-14: **1st Annual Clinical Hyperthermia Symposium and Workshop,** St. Louis, MO. Contact: Dr. B. Emami, Division of Radiation Oncology, Mallinckrodt Institute of Radiology, 4511 Forest Park Blvd., Suite 311, St. Louis, MO 63108, (314) 362-3470.

September 23-26: **4th International Conference on AC & DC Power Transmission,** London, UK. Contact: Institution of Electrical Engineers (IEE), Savoy Place, London WC2R 0BL, UK, (01) 240-1871.

September 27-30: **7th Annual Conference of the IEEE Engineering in Medicine and Biology Society,** Americana Congress Hotel, Chicago, IL. Contact: Dr. Barry Feinberg, Kendall Co., 411 Lake Zurich Rd., Barrington, IL 60010, (312) 381-0370. Followed by September 30-October 2: **38th Annual Conference on Engineering in Medicine and Biology,** Chicago, IL. Contact: Susan Leone, ACEMB, 4405 East-West Hwy., Suite 402, Bethesda, MD 20814, (301) 657-4142.

October 3-5: **2nd Congress of the European Society of Magnetic Resonance in Medicine and Biology,** Montreux, Switzerland. Contact: Dr. M.A. Hopf, 1 route de Florissant, CH-1206 Geneva, Switzerland, (41)(22) 472547.

October 7-9: **1985 International Geoscience and Remote Sensing Symposium,** University of Massachusetts, Amherst. Contact: Professor Calvin Swift, Dept. of Electrical and Computer Engineering, University of Massachusetts, Amherst, MA 01003.

October 13-17: **5th International Meeting of the Bioelectrical Repair and Growth Society,** Park Plaza Hotel, Boston, MA. Contact: Dr. S.R. Pollack, University of Pennsylvania, 119 Towne Bldg., 220 South 33rd St., Philadelphia, PA 19104, (215) 898-8241.

October 15-18: **Phased Arrays 85,** Bedford, MA. Contact: Dr. Hans Steyskal, RADC/EEA, Hanscom AFB, MA 01731, (617) 861-2052.

October 21-24: **1985 Conference on Electrical Insulation and Dielectric Phenomena,** Marriott Hotel, Amherst, NY. Contact: Steven Boggs, Ontario Hydro, 800 Kipling Ave., Toronto, Ontario M8Z 5S4, Canada, (416) 231-4111, ext. 6735.

November 5-6: **1985 Producibility of Microwave and Millimeter Integrated Circuits Conference,** Redstone Arsenal, AL. Contact: Joe Derie, U.S. Army Missile Command, Attn.: AMSMI-EE, Redstone Arsenal, AL 35898, (205) 876-8421.

November 5-7: **Review of Contractors Research on the Biological Effects of Electric and Magnetic Fields Associated with High Voltage Transmission Lines,** Radisson Mark Plaza Hotel, Alexandria, VA. Contact: Dr. William Wisecup, Aerospace Corp., Suite 4000, 955 L'Enfant Plaza, SW, Washington, DC 20024, (202) 488-6328.

EXCERPTS

NIOSH Draft Occupational RF/MW Exposure Standard

Reprinted below are excerpts from the occupational radiofrequency and microwave (RF/MW) radiation exposure standard proposed by the National Institute for Occupational Safety and Health (NIOSH) in the external review draft of its criteria document. The draft document was released at the annual meeting of the Bioelectromagnetics Society in San Francisco, CA, in June. *See story on pp.2-3.*

Explanations and Limitations of REL Usage

The explanations and limitations of recommended exposure limit (REL) usage are an integral part of the recommended Occupational Exposure Standard. It is essential to understand these explanations and limitations prior to determining compliance with this standard.

1. The RELs apply to both partial and whole-body exposures unless the provisions given in the section on "Exclusions from REL Usage" can be met.

2. All mean squared electric field strength (E^2), mean squared magnetic field strength (H^2) and equivalent plane-wave power density values shall be determined by free-space measurements (i.e., under exposure conditions in which *no part of the worker* is in contact with an electrically conductive surface whether or not the surface is grounded).

3. From 300 kHz to 300 MHz, measurement of both mean squared electric field strength (E^2) and mean squared magnetic field strength (H^2) is required for compliance. Measurement of equivalent plane-wave power density is not permitted for compliance at frequencies from 300 kHz to 300 MHz.

4. Above 300 MHz, measurement of either mean squared electric field strength (E^2), mean squared magnetic field strength (H^2), or equivalent plane-wave power density is sufficient for compliance.

5. RELs apply to both pulsed wave (PW) and continuous wave (CW) RF radiation exposures. For pulsed RF radiation sources, the average of the mean squared electric field strength, mean squared magnetic field strength or equivalent plane-wave power density is calculated by multiplying the peak pulse value of the mean squared field strength or power density by the duty cycle. The duty cycle is equal to the pulse duration in seconds multiplied by the pulse repetition rate in cycles per second.

6. All mean squared field strength and equivalent plane-wave power density measurements can be time averaged over any 6-minute period for comparison with RELs. This provision applies to CW exposures and to the average of the mean squared field strength and power density values for PW exposures.

7. For mixed or broadband fields consisting of several frequencies for which there are different REL values, the fraction of the REL incurred within each frequency range shall be determined, and the sum of all such fractions shall not exceed unity.

8. Measurements to determine compliance with the standard shall be made at distances of 5 cm or greater from any object.

9. This standard is not intended to apply to the purposeful exposure of patients by or under the direction of practitioners of the healing arts.

10. Exposure conditions which will cause an involuntary response (startle reaction) due to an RF shock or current flow are not permitted from 300 kHz to 300 GHz. In addition, exposure conditions which will cause an RF burn are not permitted from 300 kHz to 300 GHz. These restrictions apply even if the exposure limits of this standard are not exceeded. Shock and burn hazards can be controlled through the use of insulated gloves, shoes and other protective clothing; by insulating the RF source and conducting objects within the RF field; by using proper grounding techniques; or by eliminating the possibility of worker contact with the source or with conducting objects in the field. Extra precautions should be taken around long conductive objects such as wires, cables and cranes and around large ungrounded objects such as cars, trucks and buses when these objects are in close

NIOSH Draft RF/MW Exposure Limits

Frequency Range	Equivalent Plane-Wave Power Density (mW/cm^2)	Mean Squared Electric Field Strength (V^2/m^2)	Mean Squared Magnetic Field Strength (A^2/m^2)
0.3-3 MHz	50	188,500	1.33
3-30 MHz	$450/f^2$	$3{,}770(450/f^2)$	$0.027(450/f^2)$
30-300 MHz	0.5	1,885	0.013
300 MHz-3GHz	f/600	3,770(f/600)	0.027(f/600)
3 GHz-300 GHz	5	18,850	0.133

Note: f = frequency in MHz.

proximity to high power RF sources such as AM and FM broadcast antennas. The proper control measures for a particular exposure condition vary. Each case must be carefully analyzed to determine the optimum method of preventing RF shocks or burns.

11. These RELs and associated explanations, limitations and exclusions apply under all environmental conditions regardless of ambient air temperature, relative humidity, air velocity or the radiant energy input at frequencies higher than the frequency range of this recommended standard.

Exclusions from REL Usage

These exclusions from REL usage are an integral part of the recommended standard. It is essential to understand and correctly apply this information when claiming exclusions from REL usage during compliance determinations.

1. For frequencies from 300 kHz to 30 MHz, the RELs may be exceeded if it can be demonstrated that the average whole-body SAR does not exceed 0.2 W/Kg, that the spatial peak SAR does not exceed 5 W/Kg as averaged over any one gram of tissue and that RF burns and startle reactions do not occur. However, exposures greater than 50 mW/cm^2 (188,500 V^2/m^2, 1.33 A^2/m^2) will not be permitted for continuous exposures longer than 6 minutes, even if the above conditions are met.

2. For frequencies above 30 MHz, the RELs may be exceeded if it can be demonstrated that the average whole-body SAR does not exceed 0.2 W/Kg, that the spatial peak SAR does not exceed 5 W/Kg as averaged over any one gram of tissue and that RF burns and startle reactions do not occur.

VLF and RF Radiation Risks *(continued from p.1)*

Burns and Shocks

In a paper presented at the *7th Annual Meeting of the Bioelectromagnetics Society (BEMS)* held in San Francisco, CA, June 16-20, Gandhi reported that "the currents flowing through the hand of a human in conductive contact with the handle of an ungrounded van can be as high as 879 mA and produce a local SAR in the wrist of about 1045 W/Kg." This experiment was run at 3 MHz at 100 mW/cm^2.

With respect to ways of protecting workers in such electrical environments, Gandhi reported that "electrical safety shoes and gloves provide adequate protection from induced currents up to about 1 MHz."

The Utah research is an extension of ongoing work on VLF radiation hazards funded by the U.S. Air Force School of Aerospace Medicine at Brooks Air Force Base in San Antonio (see *MWN,* May and September 1983). In an earlier paper, Gandhi reported that the electric fields associated with 100 mW/cm^2 300 kHz-3 MHz fields — exposure levels allowed under the 1982 ANSI guidelines — could cause RF burns (see *Proceedings of the IEEE, 70,* 1462-1464, December 1982).

Gandhi's VLF results have been generally confirmed by Professor Bill Guy at the University of Washington in Seattle, whose work was also funded by the Air Force. Both Gandhi and Guy have found that VLF radiation can cause hot spots in the wrist.

According to William Hurt, the Air Force project officer for both studies, final reports on the studies should be available soon.

ANSI Standard Will Need Revision

In his talk at the BEMS meeting, Gandhi said that the 1982 ANSI guidelines are "clearly too high for the general population."

Similarly, in reviewing his VLF findings, Guy told the audience that the new results will require a change in the ANSI standard.

The new hot spot and body current data are likely to add fuel to the ongoing debate on the safety of human exposure to radiation from radio, television and high frequency transmitters (see *MWN,* May 1985). In Honolulu, HI, for example, measurements by the Environmental Protection Agency and the Federal Communications Commission found AM radiation (550 kHz-1.6 MHz) levels as high as 3,054 mW/cm^2 (see story p.6). Gandhi's data could also have an impact in the 54-88 MHz band, used for television broadcasting.

The findings could also increase awareness of the health risks to those who use RF energy in industry. Of special concern are workers who use RF heaters and sealers, which operate in the 3-100 MHz frequency band.

While many of the BEMS attendees agreed with the Gandhi and Guy opinions that the ANSI standard needs immediate review in light of the new data, Subcommittee IV on "Safety Levels and/or Tolerances with Respect to Personnel" of the Accredited Standards Committee C95 will not begin considering any changes until next June.

Although the C95.1 standard will continue to be an official ANSI standard, the committee will no longer be an ANSI committee; instead it will be called the Accredited Standards Committee C95. The committee will continue to be sponsored by the IEEE and the U.S. Navy.

At a meeting on June 20 immediately following the BEMS conference, Dr. Kristian Storm of the UCLA School of Medicine, chairman of the C95.IV subcommittee, said that he was aware of the new Gandhi and Guy data and that they are being studied. According to Storm, budgetary and time constraints prevent a meeting before next year, when he plans to hold a two-day session to frame a proposed revision to the 1982 standard. That meeting is tentatively scheduled to coincide with the 1986 BEMS meeting, which will be held June 1-6 at the University of Wisconsin in Madison.

The C95.IV subcommittee meeting was held in the late afternoon after the close of the BEMS meeting, when many of the participants were making their way home. Neither Gandhi nor Guy was able to attend. ●

UPDATES

BIOLOGICAL EFFECTS

Immunology in the U.S.S.R....A group of researchers at the Kiev Institute for General and Communal Hygiene report that low-level exposure to 2375 MHz microwaves first stimulates and then depresses the immune system. Rats exposed to power densities of 10-50 uW/cm^2 experience a "strain on the energy metabolism processes occurring in neutrophils over the course of three weeks of irradiation." (Neutrophils are leukocytes.) A translation of "Immunological and Hematological Effects of Low Intensity SHF-Band Electromagnetic Fields" by G.I. Vinogradov and coworkers appears in *Biological Effects of Non-Ionizing Electromagnetic Radiation* (Vol.8, No.3, June 1984). See below.

Bibliographies... The Office of Naval Research has released three new volumes in its series, *Biological Effects of Non-Ionizing Electromagnetic Radiation:* Vol.8, No.3 (June 1984), Vol.8, No.4 (September 1984) and Vol.9, No.1 (December 1984). The last volume contains a complete translation of the abstracts of the papers presented at the *All-Union Symposium on the Biological Effects of Electromagnetic Fields,* held in Pushchino, U.S.S.R. in 1982. A limited number of copies of each volume are available from the Office of Naval Research, Code 441, Arlington, VA 22217 (include a mailing label)....The U.S. Air Force has released the fifth volume in its continuing collection of the RF/MW literature, *USAFSAM Review and Analysis of Radiofrequency Radiation Bioeffects Literature* (USAFSAM-TR-85-7). This edition contains a critical look at 40 papers and a cumulative index of the 200 papers reviewed in the 5 volumes issued to date. The reviews were written by Louis Heynick and Dr. Peter Polson of SRI International in Menlo Park, CA. Copies are available from the National Technical Information Service (NTIS), Springfield, VA 22161.

Honeybees and Power Lines... Honeybee colonies near power lines can suffer adverse effects, according to an EPRI study conducted by Bernard Greenberg and Vytas Bindokas, of Bioconcern and the University of Illinois at Chicago, and James R. Gauger, of the IIT Research Institute, also in Chicago. Hives were placed at varying distances from a 765-kV line so that they were exposed to electric fields ranging from 0.65 to 7 kV/m; half of the hives were shielded to provide controls. At 4.1 kV/m, the researchers found reduced hive weight and lower propolization (deposit of resinous material collected from tree buds), and at 5.5 kV/m, they noted loss of queens and impaired foraging, indications of serious damage to a colony. At 7 kV/m, fields inside the hive reached 100 kV/m, and shock currents were as high as 500 nA. At the DOE-EPRI-NY State contractors' meeting held in St. Louis on November 7, 1984, the researchers indicated that their data "suggest that colony disturbance under a 765-kV transmission line is not a direct E-field effect, but rather the result of shocks from induced-hive or bee-body currents." A forthcoming report will describe the results of a full-scale study that exposed hives and matched controls to field or shock currents independently. The report, "The Effects of High-Voltage Transmission Lines on Honeybees" (EPRI EA-3898, Interim Report), was published in May 1985 and is available for $11.50 (prepaid) from Research Reports Center, PO Box 50490, Palo Alto, CA 94303, (415) 965-4081. (See also their earlier report, EPRI EA-1809, with the same title, dated April 1981 and pp.6-7.)

Manipulating Genes with Electricity... High voltage electrical pulses can induce the introduction of foreign DNA into plant cells — a finding that could play an important role in the genetic engineering of plants. William Langridge, of the Boyce Thompson Institute for Plant Research in Ithaca, New York, and Bao-Jian Li, of the Cunshang University in China, applied short pulses of 40-volt DC to a mixture of bacterial plasmid (extrachromosomal DNA rings) and enzyme-treated carrot cells. About 2 percent of the carrot cells took up and expressed the bacteria DNA, a number 20,000 times greater than would occur without using the technique, called electroporation. The pulses open up the carrot cell membrane, allowing the entry of the foreign DNA. Current methods for introducing foreign DNA into plant cells are difficult and limited. Electroporation may one day allow any gene to be directly introduced into plant cells. See "Zapping DNA Into Plant Cells" in the July 13 *Science News*.

COMMUNICATIONS

An Alternative to Satellites... Soviet researchers are experimenting with powerful electromagnetic pulses to create plasma clouds of charged particles in the ionosphere to reflect TV and radio signals. This technique could possibly lead to an alternative to satellites, according to a December 20, 1984 report from TASS, picked up by the *Review of International Broadcasting* (Issue No. 100, released in June). With careful aiming, the reflected signals can be directed to specific spots on the Earth's surface. The U.S. is also involved in research of this type, though much of it is classified because of its potential application to military communications. For a review of some of the ongoing research, see the collection of papers on "Ionospheric Effects on Radio Systems" in the May-June 1985 issue of *Radio Science,* Vol.20, No.3.

Cellular Phones: Promise v. Reality... Over the last few years, the public has been promised a revolution in mobile communications with the introduction of cellular telephones — already available in 60 U.S. cities, with more to come. It turns out that the promise was greater than the reality. A series of press reports at the end of June noted that the demand for cellular phones is softer than expected and the cost of providing service is more than $2,500 per subscriber. In addition to the marketing problems, the technology may not be working up to expectations. The system was originally hailed as an ingenious way of maximizing the efficient use of the frequency spectrum by dividing a region into hexagonal cells so that the same frequency could be re-used in non-adjoining cells, with a computer automatically transferring a call from one fre-

quency to another as a driver moved around the city. Before the introduction of cellular systems, a city had a maximum of 44 channels; New York City, a prime market, could only handle 12 mobile telephones at once. When the FCC authorized cellular service, they increased the number of channels to 666, allowing many more simultaneous calls. But the promise of adding capacity by splitting cells to accommodate demand is proving to be illusory. Indeed the present capacity is due only to the new FCC allocation, not to the new technology, and the cellular phone companies are in the process of going back to the FCC to ask for more spectrum space. As Andrew Pollack reported in the June 20 *New York Times*, "As the cells get smaller and closer together, coordination among different cells becomes more complex and interference more troublesome....What was pictured in theory as a nice honeycomb pattern of hexagonal cells is turning out to be more of a haphazard jumble of amoeba-shaped cells. As the pattern deviates from the optimal, overall system capacity and quality of service degrade as well." One problem is the resistance of local residents to the siting of antennas in urban areas.

COMPATIBILITY & INTERFERENCE

Woodpecker Watch... Shortwave listeners in North America have organized "The Woodpecker Project" in an effort to force the Soviet Union to control interference caused by its over-the-horizon (OTH) radar system. Coordinated by the Association of North American Radio Clubs' (ANARC) OTH Committee, the Woodpecker Project plans to ask representatives at the 1987 World Administrative Radio Conference (WARC) for High-Frequency Broadcasting to object formally to the Soviet OTH interference, which produces a "pecking" sound. To support this position, organizers of the project are recruiting volunteers to help monitor shortwave frequencies from 5-23 MHz for Woodpecker interference 24 hours a day for a total of 5 days in October; each volunteer will be asked to monitor a 3 MHz band for 3 hours. The Soviet OTH radar uses a 3 to 4 millisecond square-wave pulse with a repetition rate of 10 pulses per second, according to the project, which recently noted that the radar has been operating around 10.7 MHz. For more information, contact Robert Horvitz c/o Woodpecker Project, 1634 15th St., NW, Washington, DC 20009.

Aircraft Generated EMI...NASA is about to undertake a research program to understand and control EMI aboard aircraft. The agency is soliciting bids for the collection of data on conducted and radiated interference to digital circuits — with special attention to fast rise-time transients. One of the goals of this effort is to update existing FAA rules for the safe and compatible use of modern electronic technology. NASA had been negotiating with Chris Kendall Consultants of Mariposa, CA, on a sole-source basis, but opened up the bidding when other parties expressed an interest in the project. The closing date for responses to Solicitation No. RFP2-31865(JAC) is August 8. For more information, contact NASA's Joanne Comstock, NASA Ames Research Center, Moffett Field, CA 94035, (415) 694-5786.

EMI Survey... Frost & Sullivan, an international market research firm, is preparing a study for fall release on the U.S. market for EMI and RFI test equipment. As part of the project, the company has distributed a four-page survey questionnaire to specialists in the field. For more information, contact Raymond Cappiello, Project Director, 73 Hudson Rd., Bellerose Village, NY 11001, (516) 437-4335.

GOVERNMENT

Radiation Research Proposals... Bills have been introduced in both houses of Congress that would shift the responsibility for research on *ionizing* radiation bioeffects from the Department of Energy (DOE) to the Department of Health and Human Services (HHS). The "Radiation Research Reorganization Act" (H.R.1287), introduced by Representative Tim Wirth (D-CO) on February 26, and the "Radiation Reorganization Act" (S.525), introduced by Senator John Glenn (D-OH) on February 27, are virtually identical. Because the DOE is presently charged with the potentially conflicting roles of studying the health effects of radiation and producing and using nuclear materials, some members of Congress have raised questions about the objectivity of its bioeffects research efforts. Although the two bills apply specifically to ionizing radiation, they could open the door to a similar change for ELF (power line) radiation research, presently administered by the DOE's Electric Energy Systems Division. H.R.1287 was referred to both the House Energy and Commerce Committee's subcommittee on health and environment and the House Science and Technology Committee's subcommittee on science research and technology. Glenn's S.525 was referred to the Senate Committee on Government Affairs' subcommittee on nuclear proliferation and government processes. Glenn introduced a similar bill in 1982, S.2284, which would have set up two interagency panels to coordinate research and regulations for ionizing and non-ionizing radiation (see *MWN*, May and June 1982). That bill died in committee.

Cable Leakage Rules Reaffirmed... The FCC has reaffirmed, with minor modifications, its revised Part 76 rules for protecting aeronautical navigation and communications radio services from cable TV leakage interference. The commission argued that "reduced signal leakage is the

MICROWAVE NEWS is published bimonthly • ISSN 0275-6595 • PO Box 1799, Grand Central Station • New York, NY 10163 • (212) 725-5252 • Editor: Louis Slesin, Ph.D., Senior Editor: Mark Pinsky • Subscriptions: $200 per year ($235 overseas); single copies: $40.00
• Copyright © 1985 by Louis Slesin • Reproduction in any form is forbidden without written permission. • We invite contributions to *From the Field,* our column featuring news and opinions from the non-ionizing radiation community. Letters from readers are also welcome.

only long-term solution to the problem of interference." In a June 21 "Memorandum Opinion and Order" (50 *Federal Register* 29394, July 19), the FCC denied seven petitions for reconsideration of its rules, which were issued last November (see *MWN*, December 1984), but approved a request to delay for 5 years the mandatory use of a signal-leakage criteria test (the "Cumulative Leakage Index") by cable operators. Other revisions include: (1) the adoption of a 100 microwatt "universal trigger level for FCC notification" for new aeronautical frequencies; and (2) the determination of this threshold level will now use *average* power across a 25 kHz bandwidth in any 160 usec period, rather than *peak* power, as originally required. This latter change was requested by the National Cable Television Association. For more information, contact the FCC's Freda Lippert Thyden at (202) 632-7792 for legal concerns and the FCC's Bernard Gorden at (202) 632-9660 for technical matters.

FCC Enforcement Actions...FCC officials interrupted the start of a corporate liquidation auction because computers that did not meet the commission's RF emissions rules were among the items up for grabs, according to *The Washington Post* (July 25). Seequa Computer Corp., based in Odenton, MD, sold inadequately shielded computers as long ago as last October, a commission spokesman told the newspaper. After some discussion between company and federal representatives, the auction began and the computers were sold — although the purchasers will have to wait at least 4-6 weeks for the FCC to complete lab tests on the units....The FCC has fined three cordless phone manufacturers $2,000 each for selling cordless phones that exceed the commission's standards for radiated power emissions. Under a new sampling procedure that uses commercially available phones rather than prototypes (see *MWN*, November 1984), FCC staffers measured field strengths up to five times as high as the commission's maximum permissible limit of 10,000 uV/m at 3 meters. Matsushita Technology, Pacific Electronics Programs and Webcor Electronics were fined after failing to correct the violations despite warnings from the commission. The FCC fined three distributors of cordless phones for similar violations last January (see *MWN*, January/February 1985)....In another action, the commission has decided to require cordless phone manufacturers to label their products with warnings about the potential problems of RFI and inadequate security — including the use of one's phone by an outside party and inadvertent interaction with other nearby cordless phones. Beginning on November 1, manufacturers will have to describe their phones' security features to purchasers (50 *Federal Register* 24512, June 11). The FCC noted that the Association of Public-Safety Communications Officers (APCO) has been plagued with "drop off" calls to 911 emergency systems — no one is on the line when the call is answered. APCO has traced many of these calls to cordless phones. The FCC has taken no action on this interference problem but promises to reconsider the problem if it persists.

CDRH Reporting Review... The FDA's Center for Devices and Radiological Health (CDRH) has issued a public review draft of its "Report of the CDRH Task Force for Retrospective Review of the Recordkeeping and Reporting Requirements of 21 CFR 1002" (50 *Federal Register* 27024). The task force, set up in 1982 in response to a congressional directive requiring regulatory flexibility (see *MWN*, December 1982), recommends that manufacturers of radiation-emitting products be permitted to file less documentation than now required to prove that they are complying with CDRH regulations. In addition, the task force suggests, the types of reports required should be modified and streamlined. Comments on the recommendations are due by August 30. For more information, contact Melvyn Altman, CDRH (HFX-83), FDA, 5600 Fishers Lane, Rockville, MD 20857, (301) 443-3426.

LITIGATION

Yannon Hearing... Mrs. Antoinette Yannon's $3.5 million product liability suit against RCA for the wrongful death of her husband, Samuel Yannon, due to long-term exposure to microwave radiation, is going back to court. A hearing will be held on September 10 in the state Supreme Court in Staten Island, NY. In July 1982, a Supreme Court judge dismissed the case, but the decision was reversed on appeal (see *MWN*, June 1984). Guy Lawrence of the New York City law firm of Bower & Gardner, which is representing RCA, refused to comment on any aspect of the case. A spokesman for RCA confirmed the September 10 hearing date. Yannon worked on microwave relay equipment at the Empire State Building for 15 years. He retired from New York Telephone in 1971 and died in 1974.

Loesch Dies... Andrew Loesch, a former FAA radar technician who filed a $1.5 million suit against the FAA, claiming he developed a brain tumor from exposure to microwave radiation, died on July 23 (see *MWN*, May 1985). His attorney, Michael Allison of DeLayo and Olson in Albuquerque, NM, told *Microwave News* that the FAA denied the Loesch claim on July 19 and that a workers' compensation claim will be filed on behalf of Loesch's widow, Katherine. Allison said that he is still evaluating whether to file a suit against the manufacturers of the radiation-emitting equipment.

MEASUREMENT

NBS Report... Three members of NBS's Electromagnetic Fields Division have prepared a report, *Possible Estimation Methodologies for Electromagnetic Field Distributions in Complex Environments (Technical Note 1081)*, which outlines three ways of approximating field strengths when there are multiple sources operating at different frequencies. M. Kanda, J. Randa and N.S. Nahman outline the approaches: a statistical treatment, a numerical computation and the use of a directional probe. While the methods are still under development, the researchers expect them to help in the prediction of maximum field strengths inside buildings housing sensitive electronic and ordinance equipment and thereby prevent interference problems. The

report is available for $2.00 from the Government Printing Office, Washington, DC 20402. Order No. 003-003-02638-7.

MEDICAL APPLICATIONS

Diathermy and Low Back Pain...A placebo treatment for low back pain proved to be as effective as short-wave diathermy (SWD) or osteopathy in a study by researchers at Guy's Hospital in London. T. Gibson and coworkers at the Department of Rheumatology randomly divided 109 patients who had suffered low back pain for 2-12 months into 3 groups: one was treated with SWD, a popular therapy for low back pain, another was treated by an osteopath (chiropractor) and the third was treated with an unplugged SWD unit that appeared to be functioning. 8 weeks after 4 weeks of treatment (3 times weekly with the active or inactive SWD, once weekly by the osteopath), 59 percent of those treated with SWD reported improvement, as did 62 percent of those treated with osteopathy and 67 percent of those treated with the detuned SWD; 12 percent of the patients who received SWD noted a worsening in their condition, as did 11 percent of those treated with osteopathy and 9 percent in the placebo group. Although the authors report that their study "does not indicate that SWD and osteopathy are equivalent to no treatment," they do conclude that "our results almost certainly attest to the magnitude of the placebo response which may be achieved when harmless treatments are applied with conviction." The study, "Controlled Comparison of Short-Wave Diathermy Treatment with Osteopathic Treatment in Non-Specific Low Back Pain," appeared in the June 1 issue of *Lancet*.

MEETINGS

Power Line Contractors... The date for the DOE-EPRI-NY State contractors' meeting, *Review of Contractors Research on the Biological Effects of Electric and Magnetic Fields Associated with High Voltage Transmission Lines*, has been officially set for November 5-7 at the Radisson Mark Plaza Hotel in Alexandria, VA, (703) 845-1010 or (800) 228-9822. There will also be two workshops, one on dosimetry on November 4 and one on mechanisms on November 8, but these sessions will be restricted. When making hotel reservations, mention "DOE Contractors Review" to get a reduced rate. For more information, contact Dr. William Wisecup, Aerospace Corp., Suite 4000, 955 L'Enfant Plaza, SW, Washington, DC 20024, (202) 488-6328.

1986 Gordon Conference...A Gordon Conference is being planned for the week of June 8-13, 1986 in New Hampshire to discuss the biophysical and biochemical effects of electromagnetic fields that can influence growth and excitation processes. The registration fee will be approximately $250, including room and board. The conference follows the annual meeting of the Bioelectromagnetics Society, which will be held in Madison, WI, next year. For more information, contact Professor Howard Wachtel, University of Colorado, Boulder, CO 80309, (303) 492-7327, or Professor Betty Sisken, University of Kentucky, Lexington, KY 40506, (606) 258-5796.

EMI for Non-EMIers...R&B Enterprises is introducing a new short course, *EMI for Non-EMI Personnel*, to provide an overview of the "basic hows and whys of EMI/EMC" for those "who want to feel more secure and confident when discussing EMI/EMC." The one-day course will be offered in Philadelphia, PA on October 10. The fee is $345. Additional details from: Greg Gore, R&B Enterprises, 20 Clipper Road, West Conshohocken, PA 19428, (215) 825-1960.

MILITARY SYSTEMS

Effect of Standards... In April 1985, NATO's Advisory Group for Aerospace Research and Development (AGARD) hosted a series of two-day lectures in Lisbon, Paris and Rome on *The Impact of Proposed RF Radiation Standards on Military Operations* (AGARD Lecture Series No. 138). The invited speakers were John Mitchell, Col. Roger Graham and Dr. Jerome Krupp of the U.S. Air Force, Dr. Carl Durney of the University of Utah, Dr. Bill Guy of the University of Washington, Dr. Norbert Roberts of the University of Rochester and Dr. J. Bernhardt of the Institute for Radiation Hygiene in West Germany. Dr. Tom Rozzell of the Office of Naval Research attended the Lisbon lectures and summarized them for the June/July issue of the *Bioelectromagnetics Society Newsletter*. The following is based on Rozzell's report: Krupp reviewed the results of the long-term, low-level exposure study conducted by Guy for the Air Force: "The overall conclusion was that no cumulative ill effects could be attributed to the life-long exposure at absorption rates of 0.4 W/Kg or less." Krupp is the project officer for the study (see *MWN, July/August 1984, March and June 1985*). Krupp told the audience, "Rational review of the existing data provides no reason to predict adverse consequences from lifespan exposure to currently allowable levels of RF radiation." Graham discussed incidents of accidental overexposures to RF energy. He said, "In every case where the exposed person was an Air Force employee...they are kept under medical surveillance throughout their lives in order to detect any harmful effects that might develop." But, Graham added, medical examinations of those overexposed "have shown few, if any, consistent clinical patterns." Neurological and psychological exams have also failed to indicate any trends — except for anxiety in cases where the individuals have been concerned over their exposure. The full texts of the lectures are available from the National Technical Information Service (NTIS), Springfield, VA 22161.

National Communications Systems Expansion... The Defense Communications Agency (DCA) and the Air Force (AF) have announced plans to construct a Northeast Regional Communications Facility (NRCF) in western Massachusetts, but citizens and elected officials are resisting the proposal. The project was first described in a notice of intent to prepare a draft environmental impact statement (EIS) published in the *Federal Register* on March 28 (50

FR 12360). But most citizens in Hawley, MA, where as many as 40 transmitter towers and one microwave receiver would be sited, first learned of the project on May 15, when AF officials held a public meeting there; a second meeting was held the next day in nearby Granby, MA, near the Westover Air Force Base where the operations and receiver facilities are planned. Angered when the AF informed them that the formal comment period ended on June 1, citizens contacted their Congressman, Silvio Conte, who persuaded AF officials to extend the deadline to July 1. Conte, who, as the ranking Republican on the House of Representatives' Committee on Appropriations, wields considerable influence over the funding of the $22.7 million project, subsequently vowed to block the project after he learned that no money has yet been appropriated for it. And officials of Franklin County, which contains Hawley, have hired the Boston law firm of McGregor, Shea & Doliner to represent them in their fight to block the system. An AF spokesman confirmed that the Pentagon will proceed with development of the project, including preparation of an EIS, but added that the scope of the EIS will be expanded to consider alternatives to the Hawley site. He admitted that this change was made "because of what Conte said." A two-page background paper and a four-page proposal summary, prepared by the AF before Conte became involved, explain that the Hawley-Westover AFB sites are clearly the best alternatives and that failure to construct the NRCF would "significantly increase the risk of potential damage and/or embarrassment to the U.S. government because of delays in communications which implement/effect actions and strategies as means of implementing U.S. government policies." According to the documents, the NRCF would operate between 3 and 30 MHz with an average power output of 10 kW and a maximum average of 20 kW. The 20-watt microwave link between the Hawley site and Westover AFB will operate in the 1800 MHz band. The draft EIS is due to be completed by the late summer or early fall and the final EIS is planned for early 1986; the AF's spokesman conceded that the expanded scope could delay completion. The AF hopes to begin construction on the project in 1986 and to start operating the facility in mid-1987. For more information, contact: Major Ken Small, USAF/LEEV, Bolling AFB, Washington, DC 20332, (202) 767-4156.

OVENS

Appliance Standards... The U.S. Court of Appeals for the District of Columbia has ruled that the DOE must reconsider its 1982 decision not to set efficiency standards for major appliances, including microwave ovens. The July 16 ruling is a legal victory for a coalition of consumer groups and state governments that has sought a federal efficiency standard since the DOE concluded that such standards could not be economically justified given the potential energy savings (see *MWN*, January/February 1983). Industry officials are concerned that the addition of federal standards to the existing patchwork of state rules will cause havoc. Jack Langmead, vice-president of the Gas Appliance Manufacturers Association, told *The Washington Post* (July 17), "What we need is a single national standard to straighten out this massive confusion."

POWER LINES

Planning a Power Line...A new Oregon-to-California 330-mile transmission line is not scheduled to begin construction for another two years or to be turned on until 1990, but planning for the $400 million project is well under way. 34 public meetings were held in May to identify public concerns in an effort to select a suitable corridor for the power line. The California-Oregon Transmission Project (COTP) is being managed by the Transmission Agency of Northern California, with the participation of the federal government, state agencies, and municipal and investor-owned utilities in California. The COTP plans to build a 500 kV AC transmission line and new substations and to upgrade an existing 230 kV line to 500 kV so that California and the Pacific Northwest can sell and exchange power. (The Transmission Agency, composed of 15 publicly-owned electric utilities, was set up by the state of California in 1984 to develop a power line "in an environmentally and economically sound manner.") Six public workshops were held in July to discuss the siting of the line. After further public review in November, an environmental impact statement will be prepared, due for completion by May 1986. Laura Edlin, public affairs director for the project, told *Microwave News* that public involvement is "critical" to the planning of the line. The project is publishing a newsletter to keep interested parties informed. Contact the COTP, PO Box 660970, Sacramento, California 95866....Meanwhile, a feud is brewing as Bonneville Power increases the price Californians must pay for electricity imported over the Pacific Intertie, an existing power line connecting Oregon and California. Much of the new cost stems from the ill-fated nuclear reactors of the Washington Public Power Supply System. For details, see the July 8 *Wall Street Journal*.

STANDARDS

In Finland... The Finnish government's occupational health bureau has issued a proposal to limit exposures to stray RF fields from plastic sealers. Over an eight-hour period, maximum worker exposures would be 60 V/m for electric fields and 0.2 A/m for magnetic fields. For shorter time periods, exposures could exceed these levels up to a one-minute maximum of 300 V/m and 0.8 A/m for electric and magnetic fields, respectively. The proposal, which is available in Swedish and Finnish and which is scheduled to be adopted at the beginning of 1986, is available from the Standards Information Center, NBS, Technology Bldg., Room B166, Washington, DC 20234, (301) 921-2092. Ask for TBT No. 85.73.

C63 Ballots... Subcommittee 1 on Techniques and Developments of the Accredited Standards Committee C63 on EMC has three draft proposals up for a vote: (1) An addition to C63.4 on EMC measurements to include the

"Methods of Measurement of Radio Noise Emissions from Medical Devices" and a proposed addition to either C63.4 or a planned immunity document on "Methods of Measurement of Electromagnetic Immunity of Medical Devices." These proposals are in their third drafts and are dated April 1985 (see *MWN*, June 1984). Ballots are due by July 31. (2) The extension of C63.2 on EMC instrumentation to 40 GHz. At present the C63.2 standard only covers frequencies up to 1 GHz. Ballots on the proposal, dated May 22, are due by August 9. (3) The June 24 revision of C63.12-1984, *Recommended Practice on Procedures for Control of System Electromagnetic Compatibility.* Votes are due by August 30. For more information, contact Fred Huber, Jr., IEEE Standards Office, 345 East 47th St., New York, NY 10017, (212) 705-7960. C63's Subcommittee 1 has scheduled a meeting for August 19, immediately preceding the *IEEE 1985 International Symposium on EMC,* to be held in Wakefield, MA, August 20-22.

Change at ACGIH... Herbert Jones has retired as chairman of the American Conference of Governmental Industrial Hygienists' (ACGIH) Physical Agents Threshold Limit Values (TLV) Committee and has been replaced by David Sliney of the U.S. Army Environmental Hygiene Agency at the Aberdeen Proving Ground in Maryland. Sliney is already a member of the TLV committee and Jones is expected to continue to work with the ACGIH group, which sets standards for exposures to non-ionizing radiation as well as to noise and to heat stress.

Other Developments... The National Electrical Manufacturers Association (NEMA) is seeking comments on its proposed procedure for *Evaluating Ground Fault Circuit Interrupters for Response to Conducted RF Energy,* (February 25, 1985). For more information, contact: Manager, Engineering Dept., NEMA, 2101 L St., NW, Washington, DC 20037....A new standard, *Electrical and Mechanical Characteristics for Terrestial Microwave Relay System Antennas and Passive Reflectors* (ANSI/EIA) 195-C-1985, has been approved by ANSI's Board of Standards Review and should be available soon....The SAE's Committee AE-4 will meet on August 19 in Wakefield, MA, before the IEEE EMC meeting; see above.

ULTRASOUND

More on SCEs... In our April issue, we reported that a group from the University of Rochester had published a paper in *Science* (March 15) announcing that it had failed to replicate earlier findings that diagnostic ultrasound can increase the frequency of sister chromatid exchanges (SCEs), indicating a potential mutagenic and carcinogenic hazard. That paper has now generated two critical comments. Dr. Robert Bases of the Albert Einstein School of Medicine in the Bronx, NY, notes that the initial findings of an increased frequency of SCEs "has been confirmed and extended in publications from five laboratories in the United States and elsewhere." He posits that the mechanism of interaction may be the release of free radicals by pulsed ultrasound. The letter from Bases, who was one of the coauthors of the original SCE paper, appeared in the May 10 issue of *Science*, as did a reply by Drs. Morton Miller and Victor Ciaravino of the University of Rochester. Dr. Alice Martin of the Northwestern University Medical School in Chicago, IL, also wrote to *Science* (July 19), charging that, in their reply to Bases, Miller and Ciaravino had "erroneously present[ed] our work as supporting the hypothesis that ultrasound has no effect on SCEs." Martin reiterated her opinion that "the question of possible bioeffects of ultrasound is still unresolved." (See A.O. Martin, *Journal of Clinical Ultrasound, 12,* 11, 1984.)

VDTs

Workers' Compensation Settlement...A San Francisco, CA, legal writer has received a $15,000 settlement from her former employer's insurance company after filing a workers' compensation claim alleging that VDT use caused her debilitating eyestrain. Five ophthalmologists examined writer Jeanne Robinson and, though none clearly supported her claim, defense attorney Kevin Haney told *Microwave News* that his clients agreed to an out-of-court settlement to "get the thing disposed of." Judge Jane O'Neill of the California Workers' Compensation Appeals Board approved the settlement on March 5, specifically citing materials submitted by ophthalmologist Dr. William F. Hoyt, but Hoyt recently claimed in an interview that Robinson's claim is "fraudulent and has no merit whatsoever."

ETC...

Assorted Notes...*The Journal of Microwave Power* has a new look. Volume 20, Number 1, the first issue of 1985 and the first under the editorship of Dr. W.A. Geoffrey Voss, has an eight-and-a-half by eleven-inch format and features nine research papers and a section on patents and book reviews. Among the papers is a re-analysis by Dr. Allan Frey of Dr. Budd Appleton's data on cataract risks due to exposure to microwave radiation — first reported in the November 1984 issue of *Microwave News*. The *Journal* is available free with membership in the International Microwave Power Institute (IMPI). Dues are $75.00 a year. Contact: IMPI, Tower Suite 520, 301 Maple Ave. West, Vienna, VA 22180, (703) 281-1515....Lightning strikes may not be random. According to an article in *The Washington Post* (June 27), Drs. Raul Lopez and Ronald Holle at NOAA's Environmental Research Labs in Boulder, CO, have found that local topography plays a major role in determining where a lightning bolt will strike. One study area was found to be hit by lightning more than 25 times each summer (see also the July 13 *Science News*) ....Radio Marti, U.S. broadcasts to Cuba, went on the air on May 20, and all those fears of Cuban retaliation by jamming American radio stations have not materialized. But Radio Marti has brought about one major policy change: according to a dispatch by Reuters on June 18, Cuban radio has lifted its ban on Frank Sinatra, which has been in effect since the early 1960's. "Come Fly With Me" is once again on the Cuban airwaves.

CLASSIFIEDS

RADHAZ/EMC SERVICES

Radhaz/EMC site surveys, training, testing and consulting services by highly skilled and experienced professional personnel. Write or call for complete brochure. R&B Enterprises, 20 Clipper Road, West Conshohocken, PA 19428, (215) 825-1960.

Gerling Laboratories

Microwave oven technologists providing consultation and technical services on all phases of microwave oven design and performance. Write for a copy of our *Technical Background and Consulting Rate Sheet*. 1628 Kansas Avenue, Modesto, CA 95351, (209) 521-6549. Telex: 466668/GLABS CI.

Electropollution Symposium

Howard University, Washington, DC
September 9, 1985

Active workers in the field of radiofrequency and microwave biology are invited to submit an abstract. Best five will receive awards for travel and accommodations. Deadline for applications is August 26.

Contact:

Professor Richard Millis
Howard University
(202) 636-6933.

The Health Physics of Non-Ionizing Radiation

October 27 - November 1, 1985 – $1,000

Comprehensive one week course provides the health physicist with an overview of the many problems associated with using non-ionizing radiation in both industry and public environments. Some topics to be covered are: radiofrequency and microwave radiation, lasers, optical and ultraviolet sources and magnetic fields.

Application Forms and/or Information:

Dr. E.L. Alexander
Physics Department
University of Lowell
Lowell, MA 01854
(617) 453-1045.

ADVERTISE IN MICROWAVE NEWS

Our readers rely on *Microwave News* for information they can trust. Your advertisement will get noticed here, and you'll be impressed by the response.

Rates start at $50 for 1/32 of a page, $95 for 1/16 and $175 for 1/8. For more information, call Mark Pinsky at (212) 725-5252.

In Our Next Issue:
Complete Coverage of the BEMS Conference

ORDER MICROWAVE NEWS PUBLICATIONS
SUBSCRIBE TO MICROWAVE NEWS AND VDT NEWS

□ Payment Enclosed □ Bill Me

I want to subscribe to **MICROWAVE NEWS.**

□ One Year (6 Issues)
$200 US, Canada; $235 Foreign

□ Six Month Trial (3 Issues)
$105 US, Canada; $125 Foreign

□ I want to subscribe to **VDT News.**
$42 for six bimonthly issues
(Add $10 outside U.S.)

Name _____

Address _____

City _____

State/Zip _____

Make checks payable to: **Microwave News,** PO Box 1799, Grand Central Station, New York, NY 10163, (212) 725-5252.

MICRO WAVE NEWS

Vol.VI No.4 | A Report on Non-Ionizing Radiation | July/August 1986

INSIDE . . .

HIGHLIGHTS pp.2-9

EPA's Four Options for Public Exposures to RF/MW Radiation

U.K.'s NRPB Proposes ELF, RF & MW Standards

Two ELF Studies Support Wertheimer-Leeper Exposure Estimates

VDT Pregnancy Studies Increase Uncertainty Over Possible Hazards

VDTs, Stress and Smoking Linked to Problem Pregnancies

Relaxation of ANSI RF/MW Safety Standard Proposed

Australian Power Line Dispute

DoD's TEMPEST Program Badly Run, GAO Reports

Vernon Microwave Radiation Levels in Picowatt Range

NAS-NRC: Our Electrical Environment

FROM THE FIELD p.9

Wertheimer and Leeper: Estimating Residential ELF Exposures

EXCERPTS p.3

EPA's Four Options for RF/MW Radiation

UPDATES pp.10-13

Ovens Affect DBS ☐ Calming with MWs ☐ No Risk Due to DC Power Line in Minnesota ☐ NMRI EMI to Pacemakers ☐ BRAGS in Holland ☐ Oven Burns ☐ Rozzell Leaves ONR ☐ Power Line Noise Standards ☐ More on Shocks and Burns ☐ New from NBS ☐ IRPA in 1988 ☐ Supersecret EMI ☐ Herb Pohl Dies ☐ EMPRESS II Schedule ☐ FCC Denies ARRL EMI Petition ☐ NAB Tutorial on RF Safety ☐ Captain Midnight Nabbed ☐ Summer Reading ☐ and more . . .

Conferences p.15

Classifieds p.16

Human Tumor Cells Thrive in ELF Magnetic Fields

Human tumor cells proliferate more easily and are more immune to attack when exposed to power line fields, according to Dr. Jerry Phillips of the Cancer Therapy and Research Foundation in San Antonio, TX.

Because the field effects persist for months after exposure to extremely low frequency (ELF) radiation, Phillips argues that 60 Hz fields "are capable of producing significant permanent changes in cellular structure and function."

Phillips's results, presented in a series of recent papers, may be the first step in explaining the abnormally high cancer rates identified among people exposed to electromagnetic fields (EMFs). "Our studies are very much in concert with the epidemiological studies that have been published," Phillips told *Microwave News* in a telephone interview.

A recent review of epidemiological surveys by Dr. Tom Tenforde of the Lawrence Berkeley Lab in California indicates that 15 of 17 reports showed "some apparent correlation between cancer and EMFs" (see *MWN*, March/April 1986). New findings continue to support an association between ELF and cancer (see *MWN*, May/June 1986).

(continued on p.13)

Workers Claim Radar Accident at Maine Shipyard

As many as 23 workers may have been exposed to high levels of radar radiation at the Bath Iron Works (BIW) shipyard in Portland, Maine, on March 19. BIW officials contest the men's claim that a U.S. Navy ship's radar was accidentally turned on while they worked nearby.

Most of the men reported facial burns, red arms and suntans following the alleged incident, even though it rained that day. Among the other most common complaints were severe headaches, irritated eyes, nausea and exhaustion. At least one worker says he is still suffering severe ill effects and has not returned to work.

The radiation came from an AN/SPS-49 long-range air-search radar aboard the U.S.S. Taylor, a guided-missile frigate, according to officials of Local 6 of the Industrial Union of Marine and Shipbuilders of America, which represents the workers. The radar was built by the Raytheon Co. of Wayland, MA.

A BIW spokesman told *Microwave News* that the radar was "sector-blanked" — that is, it could not have exposed the men in the shipyard. But Jim Mackie, the chief steward of Local 6, disagreed: "All somebody had to do was hit one button and the sector-blanking would have been turned off," he said in an interview.

Mackie pointed out that, at the time the radar is believed to have been on, walkie-talkies stopped working in the yard and fire alarms went off in the drydock for no apparent reason.

(continued on p.14)

EPA's Four Options for Public Exposures to RF/MW Radiation

The Environmental Protection Agency (EPA) has proposed options for protecting the public from radiofrequency and microwave (RF/MW) radiation exposures: maximum specific absorption rates (SARs) of 0.04, 0.08 and 0.4 W/Kg, which translate into power densities of 100, 200 and 1,000 uW/cm², respectively. A fourth option is to take no official regulatory action (see box).

Which option EPA will finally select depends on numerous scientific and policy issues; in its *Federal Register* notice, the agency asks for public comments on how these issues should be resolved. Many key questions are unclear: EPA indicates that frequency-dependent power densities would be set based on the SARs but does not specify where, between 10 kHz and 100 GHz, the levels would change — that is, what is the resonant frequency range.

When and if EPA adopts — and the President approves — public exposure limits, formally called "Federal Guidance," affected agencies will be responsible for implementing them.

EPA began work on the guidance in the late 1970s and, in 1982, asked for public comments on six questions related to standard-setting (see *MWN*, January/February 1983). In 1984, the agency was about to propose what is now called option 1 (100 uW/cm²), but backed off in the face of opposition from EPA's policy office (see *MWN*, June and July/August 1984 and September/October 1985).

Since 1984, EPA's Office of Radiation Programs has waged an uphill battle against its own policy office and the Office of Management and Budget to propose the guidance. Delays followed delays and now, instead of proposing a single set of limits, EPA is again seeking public comments on a wide range of issues. According to the current timetable, EPA will issue a final guidance in December 1987. But it is more likely that the agency will be forced to issue a new proposal — and yet again ask for public comments — when it finally chooses one of the options. If so, the final guidance will be delayed at least until 1989.

Following a series of copyediting snafus, the EPA proposal finally appeared in the *Federal Register* on July 30 (51 *FR* 27,318) — more than six weeks after its release on June 12. Comments are due by October 28. EPA is sponsoring a public hearing September 22-23 at the GSA auditorium (18th and F Sts., NW) in Washington, DC.

Key Issues To Be Settled

At the heart of the decision on which option to select are three key questions: What margin of safety should EPA use to protect the public? How should it deal with non-thermal effects? and How should it resolve the question of RF/MW-induced carcinogenesis?

EPA states that adverse effects "begin to occur" between 1 and 4 W/Kg and that the exposure limits will be derived by applying a suitable safety factor — between 10 and 1,000 — "to compensate for unknowns and uncertainties."

The public health significance of non-thermal effects, at SARs of less than 1 W/Kg, "is not well understood," according to EPA: "The overall implications for human health of low-level non-thermal effects [are] not clear... further research is required to determine... whether they constitute a hazard to human health."

EPA states that it "believes RF radiation should now be treated as a non-carcinogen." Nevertheless, citing "some preliminary and unconfirmed studies," principally the long-term exposure study at the University of Washington in Seattle, in which rats exposed to an SAR of 0.4 W/Kg had increased rates of tumors, the agency left the door open to changing its mind, noting that the issue of carcinogenesis "is not yet resolved and could affect EPA's assessment."

Among the factors which will influence EPA's choice of the appropriate margin of safety are: (1) undetected sensitivities to radiation; (2) validity of animal data for gauging risks to humans; (3) lack of long-term exposure studies; (4) reliability of extrapolating from animal data to humans; (5) natural environmental and genetic variations among humans; (6) variations in environmental exposure conditions; (7) ill-characterized non-thermal effects; (8) lack of sensory mechanisms for warning against overexposure; (9) adequacy of the human thermoregulatory system; and (10) absence of a clear threshold for adverse effects.

Dealing with Shocks and Burns

"It is impractical to specify numerical electromagnetic field intensity limits that prevent all possible shock and burn effects," according to EPA. Under the three specific options, EPA estimates the induced currents in a grounded individual at 3 MHz to be 45 mA, 247 mA and 553 mA for options 1, 2 and 3, respectively. EPA points out that only option 1 results in a threshold for RF burns of less than 100 mA, as proposed by the National Institute for Occupational Safety and Health.

EPA advises that, "as a minimum, low frequency fields

U.K.'s NRPB Proposes ELF, RF & MW Standards

The United Kingdom's National Radiological Protection Board (NRPB) has just published proposed standards for occupational and general public exposures to non-ionizing radiation below 300 GHz. For occupational exposures to radiofrequency (RF) and microwave (MW) radiation, NRPB recommends the same levels as those set by the American National Standards Institute (ANSI) in 1982; for occupational exposures at 50 Hz, it proposes 30 kV/m and 10 mT for the electric and magnetic fields, respectively. For all frequencies, general population exposure limits are no more than 40 percent of the occupational levels.

NRPB has invited comments on its proposal and plans to issue a final standard by early 1987. *Advice on the Protection of Workers and Members of the Public from the Possible Hazards of Electric and Magnetic Fields with Frequencies Below 300 GHz: A Consultative Document* (May 1986) is available from NRPB, Chilton, Didcot, Oxon OX11 0RQ, U.K.

Microwave News will publish a full report on the NRPB proposal in our next issue.

EPA's Four Options

Excerpts from EPA's Federal Register *notice.*

Option 1: Guidance Based on an SAR of 0.04 W/Kg. Controlling public exposure by limiting whole-body average specific absorption rates (SARs) to 0.04 watts per kilogram (W/Kg) for frequencies above 3 megahertz (MHz) and by limiting electric field intensity to 87 volts per meter (V/m) and magnetic field intensity to 0.23 amperes per meter (A/m) at frequencies below 3 MHz.

This option represents a "no effects" level by protecting against thermally-related health effects in humans, including most sensitive subgroups of the population. No measurable changes in core temperature would occur at this level nor would any thermoregulatory responses be initiated. This level is consistent with the usual practice of providing substantially more protective standards (here, by a factor of 10, when compared to, for example, the 1982 ANSI voluntary standard of 0.4 W/Kg) for the public than those recommended for occupational exposures. This level might be viewed as unnecessarily stringent in that the health protection provided may not be commensurate with its cost, particularly in view of the present uncertainties surrounding low-level and nonthermal effects.

Option 2: Guidance Based on an SAR of 0.08 W/Kg. Controlling public exposure by limiting whole-body average SARs to 0.08 W/Kg for frequencies above 3 MHz and by limiting electric field intensity to 275 V/m and magnetic field intensity to 0.73 A/m for frequencies below 3 MHz.

This option also effectively represents a "no effects" level by protecting against thermally related health effects in humans, including most sensitive subgroups of the population. No changes in core temperature should occur at this level nor should any thermoregulatory responses be initiated. Also consistent with the usual practice of generally providing more protective standards for the public than those recommended for occupational exposures, this level differs from Option 1 in that it is lower than, for example, the 1982 ANSI guide by a factor of 5 rather than a factor of 10, as given in Option 1. This option is similar to the Massachusetts standard, to the IRPA guideline in the resonant frequency range and to the exposure limits recently recommended by the NCRP. The agency is particularly interested in comment on this option, because 42 U.S.C. 2021(h) states that the administrator shall consult with the NCRP, among others, on radiation matters.

Option 3: Guidance Based on an SAR of 0.4 W/Kg. Controlling public exposure by limiting whole-body average SARs to 0.4 W/Kg for frequencies above 3 MHz and by limiting electric field intensity to 614 V/m and magnetic field intensity to 1.63 A/m for frequencies below 3 MHz.

This option should protect against thermal effects except in possibly more susceptible or sensitive people or possibly at high ambient temperatures and humidities. This level corresponds to the lower end of the range postulated to be associated with the onset of thermoregulatory responses in humans. Effects that occur below this level do not, for the most part, seem to be caused by generalized heating. The 1982 ANSI standard, set at this level, does not differentiate between occupational and public exposure but noted, "...these guides are offered as upper limits of exposure, particularly for the population at large." Various groups in the broadcasting industry have indicated to EPA their willingness to comply with a guideline at this level (letters placed in the central docket). The agency is particularly interested in comment on this option, because it is similar to the 1982 ANSI guide voluntarily adopted by much of the broadcast industry and is to be used by the FCC to determine the need for environmental impact analyses for new and renewal license applications.

Option 4: Conduct Other Activities in Lieu of Adopting Federal Radiation Protection Guidance for RF Radiation. In lieu of adopting Federal Guidance for RF radiation, establishing public awareness programs to distribute information on health effects and environmental measurements as well as provide technical assistance to states and federal agencies.

This is a nonregulatory option, and it would provide public health protection only as it is realized indirectly through the advice and technical assistance provided by EPA to federal agencies, states or industry. Taking no regulatory action at this time could permit any further regulatory action to be based on more refined biological, technical and economic analyses. For example, allowing more time for additional research to identify and quantify adverse health effects in the population may result in more improved risk estimates. It is not clear whether this approach will meet the perceived need of federal agencies, states or industry that have requested uniform federal exposure guideliness, and EPA seeks comments on this issue.

should be limited to intensities that prevent accident-causing startle reactions in ungrounded individuals who may momentarily contact grounded objects" in high RF fields.

In addition, the EPA proposal:

- Specifies no limits for peak intensities of pulsed fields;
- Suggests limits that are ten times less stringent for exposures of less than six minutes in any one hour, as long as the total energy absorbed is no greater than would be absorbed in one hour under continuous exposure;
- States that it is "impractical to distinguish between partial-body and whole-body exposures" and proposes that the limits apply to all exposures;
- Makes no special provisions for modulated fields because the scientific data "is not considered to be sufficiently developed";
- Excludes exposures from medical devices and consumer products.

EPA's economic analyses (see *MWN*, September/October 1985) show that even the most stringent controls (option 1) would have a relatively minor impact on federal RF/MW activities – EPA notes that even though some agencies differed with these estimates, one part of the Defense Department agreed.

Comments on the EPA options should be sent to: Central Docket Section (LE-131), U.S. EPA, Attention: Docket No.A-81-43, Washington, D.C. 20460.

The EPA Office of Radiation Programs recently moved. The new telephone numbers are: Dave Janes and Doreen Hill at (202) 475-9626; Norbert Hankin at (202) 475-9630. Their mailing address remains the same.

Wertheimer-Leeper ELF Exposure Estimates Confirmed

Reports from two ongoing epidemiological studies have confirmed the reliability of the coding scheme developed by Dr. Nancy Wertheimer and Ed Leeper to estimate human exposures to extremely low frequency (ELF) magnetic fields.

At the Bioelectromagnetics Society (BEMS) meeting in Madison, WI, in June, members of both study teams reported that detailed magnetic field measurements supported the Wertheimer-Leeper claim that residential exposures can be estimated by checking the wiring configuration near a given home. The two studies, funded by the New York State Power Line Project, are designed to test the Wertheimer-Leeper finding of a link between exposures to weak alternating magnetic fields and cancer (see *MWN*, September 1983).

Neither research group presented any results at BEMS on the key question of the possible relationship between ELF fields and cancer. These are expected to be ready for the Department of Energy and Electric Power Research Institute (EPRI) contractors review to be held in Denver, CO, in November.

Ground Currents

Bill Kaune of the Battelle Pacific Northwest Labs concluded that the "Wertheimer-Leeper method of wiring classification is correlated with residential magnetic fields" and that "our data are supportive of the idea, first suggested by Wertheimer and Leeper, that ground currents are a significant source of residential magnetic fields." Kaune pointed out that there is still considerable variability in magnetic fields within each category.

Drs. Frank Barnes and Howard Wachtel of the University of Colorado in Boulder reached a similar conclusion: on average, the magnetic fields are determined by sources outside the house, in a manner consistent with the Wertheimer-Leeper coding scheme. They too found that there can be substantial variation among different houses within a given class.

Asked whether he agreed with Kaune on the importance of ground currents, Wachtel told *Microwave News* that the greatest contributions to the magnetic fields come from outside the house and that they might be due to the ground currents. Household power does not affect the magnetic fields inside the home, he said.

In a telephone interview, Dr. David Savitz, an epidemiologist at the University of North Carolina in Chapel Hill who is in the process of analyzing the Colorado data, called the new findings "a clear confirmation of the Wertheimer-Leeper exposure methodology."

This classification scheme has been criticized in the past. For instance, in an evaluation for EPRI, Daniel Roth, a consultant, reported that, "It is difficult...to accept Wertheimer and Leeper's conjecture that wiring configuration was a surrogate measure for magnetic fields..." (see *MWN*, May 1985).

Nevertheless, the method has won a considerable following — perhaps too great. Wertheimer and Leeper are now worried that others are using their coding system without first checking as to whether there is a correlation between local wiring and household magnetic fields in specific study areas. They are particularly concerned about the use of their technique in Europe (see "From the Field" on p.9).

MICROWAVE NEWS is published bimonthly • ISSN 0275-6595 • PO Box 1799, Grand Central Station, New York, NY 10163 • (212) 517-2800 • Editor and Publisher: Louis Slesin, Ph.D.; Senior Editor: Mark Pinsky; Associate Editor: Amy Rosenberg • Subscriptions: $200 per year ($235 overseas); single copies: $40.00 • Copyright © 1986 by Louis Slesin • Reproduction in any form is forbidden without written permission. • We invite contributions to *From the Field*, our column featuring news and opinions from the non-ionizing radiation community. Letters from readers are also welcome.

VDT Pregnancy Studies Increase Uncertainty Over Possible Hazards

New and previously released epidemiological studies presented in May at a conference on video display terminals (VDTs) in Stockholm, Sweden, suggested that VDT work might adversely affect pregnant women, although most speakers dismissed the possibility of any risk.

Of the five major studies presented, four showed some positive associations. Two indicated increased rates of cardiovascular abnormalities in children born to women who used VDTs. A third suggested a tendency toward increased rates of spontaneous abortions among women who worked moderate amounts of time at VDTs — but not among those who worked long periods at VDTs. And the fourth found higher rates of abnormal pregnancies among VDT operators who were under stress.

Only one scientist reported an increased risk and advised against VDT work during pregnancy. Several researchers, while discounting their positive results as anomalous, called for further epidemiological studies.

Heart Defects In Sweden and Finland

A Swedish study of more than 4,000 births between 1980 and 1983 found 57 "significant malformations" among offspring of women with some or considerable VDT exposure, compared to 9 such malformations among babies of those with little or no exposure — yielding an odds ratio of 1.9, or a near doubling of the risk of defects. Lead researcher Peter Westerholm of the Swedish Trade Union Confederation admitted that this difference was of borderline statistical significance but concluded that there was no increased risk.

Among the 57 births involving serious defects, Westerholm and coworker Anders Ericson of Sweden's National Board of Health and Social Welfare found 12 cases of cardiovascular malformations, but they found no defects of this type in the control group.

The study team used computerized personnel records to identify job categories; employers and trade union officials subsequently estimated VDT use.

Westerholm reported that the group of women who spent moderate amounts of time doing VDT work had the highest rate — 3.4 percent — of significantly malformed babies, compared to 1.6 percent or less for those who did either more or less work. He called this finding "paradoxical," saying

that the highest rate should have occurred among the women with the greatest exposures.

Dr. Karel Marha of the Canadian Center for Occupational Health and Safety in Hamilton, Ontario, responded from the audience that neither Westerholm's study nor any of the others controlled for "unintended" exposures to terminals – the amount of time a woman is not operating a VDT but is nonetheless working near one. "I would like to see an epidemiological study where exposure is well-defined relative to the location of the VDT," he said.

A second study also showed an increase in cardiovascular abnormalities among children born to women who used VDTs. Here again, the increase occurred only among part-time VDT operators. A group led by Dr. Kari Kurppa of the Institute of Occupational Health in Helsinki, Finland, reported 13 such birth defects among children of exposed women, compared to 8 among offspring of unexposed women (odds ratio of 1.6). Of the 13, 8 were among part-time workers (less than 4 hours/day), compared to only 3 among controls.

Kurppa's team had previously reported the results of this case-referent study in *The Lancet* (December 8, 1984) and in the *Scandinavian Journal of Work, Environment and Health, 11,* pp.353-356, 1985 (see *MWN,* January/February 1985 and March/April 1986, respectively).

The seemingly inconsistent finding of increased pregnancy risks among operators who worked part-time at VDTs showed up yet again in the presentation by Canadian researcher Dr. Alison McDonald. Reporting on data first released in 1984, she pointed out an increased rate of abnormal pregnancies among moderate VDT operators but not among more regular users.

McDonald discounted her positive results, not only because the dose-response relationship was unusual but also because the rate of spontaneous abortions among non-VDT workers was lower than expected. She attributed the positive findings to recall bias and concluded that there is "no convincing evidence that use of VDTs during pregnancy increases birth defects or spontaneous abortions."

Dr. Henryk Mikolajczyk of the Institute of Occupational Medicine in Lodz, Poland, was the only speaker who concluded that VDTs pose a risk to pregnant women. His survey of 185 women, who worked for the Polish Airlines (135 women) or for a building construction bureau (50 women), indicated that work at VDTs under high-stress conditions may harm fetal development.

At the airline office, where the women experienced high levels of stress, the 89 VDT operators suffered 22 spontaneous abortions, compared to 8 among the 46 controls. At the other, low-stress office, however, none of the VDT users miscarried, while 5 of the controls reported spontaneous abortions.

VDTs, Stress and Smoking Linked to Problem Pregnancies

A new, two-part study indicates that VDT exposure, stress and smoking are all related to abnormal pregnancy outcomes, leaving open the possibility of a link between VDTs and birth defects and/or spontaneous abortions.

Swedish researchers Anders Ericson of the National Board of Health and Social Welfare and Dr. Bengt Kallen of the University of Lund concluded that, "The question of a possible reproductive hazard associated with video screen work is by no means finally settled." They believe that the possible risk of birth defects is greater than that of spontaneous abortions, though they doubt that VDT work increases either significantly.

After examining national birth registry and medical records of approximately 10,000 pregnancies, Ericson and Kallen reported indications of an increased risk of problem pregnancies among women with the greatest VDT exposure. Interestingly, of the three job categories classified as "high" exposure groups – computer personnel, travel agency clerks and insurance clerks – computer personnel suffered a markedly higher rate of significant infant malformations than did the other two groups, accounting for the increase of the whole "high" exposure group relative to the "low" and "medium" groups.

Ericson and Kallen also compared pregnancy outcomes from 1976-1977 to those from 1980-1981 and observed "faint indications" of increased spontaneous abortion and malformation rates in the latter period, when VDTs were more widely used. The number of spontaneous abortions in 1976-1977 was lower than expected, the authors warned.

Investigating further, Ericson and Kallen ran a case-control study of 522 cases of significant birth defects and spontaneous abortions compared to 1,032 controls. As in part one, they analyzed the data according to low, medium and high VDT exposures.

They found a statistically significant, dose-dependent association between VDT work and birth defects but cautioned that they were unable to separate VDT work from other variables. "If a relation between birth defects and video screen work is actually present," they wrote, "it is most likely an effect of stress at work, perhaps combined with smoking."

The researchers noted that they included only spontaneous abortion cases for which women were hospitalized and thus may have excluded early miscarriages; they also cautioned that the data collected by questionnaires in the second part of the study may have suffered from recall bias.

The study papers, "An Epidemiological Study of Work with Video Screens and Pregnancy Outcome: I. A Registry Study" and "II. A Case-Control Study," appeared in the *American Journal of Industrial Medicine, 9,* pp.447-457 and pp.459-475, respectively, 1986. They were originally published last year in Swedish.

Relaxation of ANSI RF/MW Safety Standard Proposed; Literature Review Incomplete

The first draft revision of the 1982 American National Standards Institute (ANSI) safety standard for human exposures to radiofrequency and microwave (RF/MW) radiation includes a number of proposals to relax the limits.

At a two-day meeting in Madison, WI, June 6-7, Dr. Kristian Storm, chairman of subcommittee C95.IV, which is rewriting the standard, outlined some of the proposed changes. These include:

- Doubling the allowed exposure levels above 3 GHz from 5 mW/cm² to 10 mW/cm² and extending that limit from the present 100 GHz to 300 GHz.
- Adding protection against shock and burns, while loosening the allowable exposures to magnetic fields at low frequencies and extending the standard's applicability down to 3 kHz.
- Increasing the limits for partial-body exposures from the present 8 W/Kg possibly up to 24 W/Kg.
- Exempting medical diagnostic devices.

The specificity of the proposed changes caught many members of the subcommittee by surprise because the review and analysis of research papers — the basis for the new standard — are incomplete. Of the 310 recent papers that the subcommittee has identified as possibly germane to the revision, only 43 have so far been evaluated.

Speaker after speaker said it was too early to talk about biological thresholds for radiation effects because the various working groups have not completed the evaluations. Dr. Joe Lary of the National Institute for Occupational Safety and Health asked, "How are we going to get a consensus if the literature review isn't done?"

"We must proceed, time is of the essence," Storm replied. Under ANSI rules, all standards must be reaffirmed or revised every five years; action is therefore due by 1987.

In a series of interviews with *Microwave News,* most subcommittee members said that they agreed with Lary. Jules Cohen, a consultant to the broadcasting industry, said "It is too early to vote on biologically-based limits." And Dr. John Monahan of the Food and Drug Administration (FDA) commented, "It's all backwards." Storm was supported by the subcommittee's secretary, Dr. John Osepchuk of Raytheon, who said that there was no need to wait for the literature review because we "more or less know where things should go."

The subcommittee approved the extension of the standard's frequency limits down to 3 kHz and up to 300 GHz but did not vote on any exposure limits.

A Two-Tier Standard

There was extended debate on whether the standard should be changed to recommend different limits for workers and for the general public, prompted in large part by a letter from FDA's Dr. Mays Swicord, who was unable to attend the meeting. Swicord wrote, in part: "Without convincing and well-substantiated arguments to the contrary, different exposure limits should be adopted" for each group. He noted that the International Radiation Protection Association (IRPA) and the National Council on Radiation Protection and Measurements (NCRP) have adopted two-tier standards, in contrast to the 1982 ANSI standard.

Dr. Carl Sutton, a medical doctor, favored a two-tier standard as "the only way to go," while Ralph Justus of the National Association of Broadcasters argued against it. Dr. Bud Appleton, a consultant, said that there was no need for two standards because there are no chronic effects from exposure. Others, like Dr. John Bergeron of General Electric and Dr. Elliot Postow of the Naval Medical R&D Command, suggested that the subcommittee should only recommend an occupational standard. But Dr. Quirino Balzano of Motorola warned that if ANSI fails to set a population standard, everybody will use the recently released NCRP standard that specifies fivefold stricter limits for the public than for workers (see *MWN,* May/June 1986).

The problem of how to handle the threat of shock and burns at low frequencies swayed many in favor of a dual standard. While workers could be trained to minimize these risks, most of the subcommittee agreed that this would be an impractical solution for the public.

The final compromise was to adopt the concept of different standards for workers and for the public, while leaving the door open to the possibility that the subcommittee may recommend the same limits for both groups in specific frequency bands. When the question was called for a vote, some subcommittee members, such as Dr. Eleanor Adair of the John Pierce Foundation, asked whether it was appropriate to vote when the literature data base was incomplete. Storm insisted it was appropriate, saying, "We have a mandate and time is short."

Two Options for Shocks and Burns

The most detailed discussion of new research focused on the threat of shocks and burns at low frequencies. Awareness of these risks stems from research by Drs. Om Gandhi of the University of Utah in Salt Lake City and Bill Guy of the University of Washington in Seattle (see *MWN,* July/August 1985 and the "Biological Effects" Update on p.10). Each offered a different way of minimizing these hazards, however, arguing that the other's proposal was too strict.

Gandhi suggested tightening the time-averaged power density limits by a factor of ten in the 300 kHz to 300 MHz band; Guy called this "ridiculous" because the problem only exists for high power sources. On the other hand, Guy favored a maximum body current of 50 milliamps (mA) and training workers to protect themselves. Gandhi questioned how such a limit could be enforced and said that this approach was "overly restrictive" because a 50 mA limit represented a tightening of the electric field standard limit by a factor of 16 and of the power density by a factor of 256.

Richard Tell of the Environmental Protection Agency noted that, below 300 MHz, the new electric field standard for the general population may have to be tightened by more

than the factor of ten proposed by Gandhi. And Storm observed that "There is a clear need to do something at low frequencies." But no consensus emerged.

Proposal for 10 mW/cm² Standard Above 3 GHz

Guy and Gandhi also disagreed on the preferred limits at higher frequencies. Gandhi said that he was against doubling the exposure limit to 10 mW/cm² above 3 GHz, while Guy said that he was not taking any side. Raytheon's Osepchuk said that the proposal was based on the desire to match the infrared (IR) standard of 10 mW/cm² above 300 GHz.

Guy argued that temperature distribution at 3 GHz is very similar to that associated with IR radiation. Gandhi countered that IR and millimeter waves are very different because millimeter waves can penetrate clothing while IR cannot and that the two types of radiation will therefore cause very different thermal loads.

Some of those present, like Gandhi, questioned the origin of the IR 10 mW/cm² standard. Only the ANSI laser standard of 10 mW/cm² was mentioned as the possible source of the IR limit.

NIOSH's Lary said that he did not think that 10 mW/cm² would be sufficiently protective below 30 GHz. Motorola's Balzano agreed.

No one raised the question of how to handle the results of the long-term, chronic-exposure study from Guy's lab suggesting that microwaves can promote cancer (see *MWN*, July/August 1984 and March 1985).

Are Committee Members Liable?

At a meeting of the full C95 committee on June 4, the panel discussed at length whether members of standard-setting committees are liable for their actions — an issue which gained widespread significance in 1982 when the U.S. Supreme Court ruled that the American Society of Mechanical Engineers was liable for a multi-million dollar award as a result of the unethical conduct of one of its committee members in developing a boiler standard (see *MWN*, June 1982).

Both Bertram Stanleigh of the IEEE and Steve Caine of the Navy, the two sponsors of the C95 committee, said that only their designated representatives were protected. Raytheon's Osepchuk argued that the IEEE should indemnify all the committee members. Stanleigh said that he would advise the IEEE management of the request but doubted there would be a change of policy.

Some members of the subcommittee rewriting the RF/MW safety standard abstained from voting out of concern over possible later liability.

Australian Power Line Dispute

A controversy over the siting of a power line is raging in the state of Victoria, Australia. At issue is an 8 km, 220 kV, 50 Hz line that would run between Richmond and Brunswick at a cost of $12 million (Australian).

In an effort to quell public opposition, the state government of Victoria brought in Dr. H.B. Graves, formerly of Pennsylvania State University in University Park and now a private consultant based in Corpus Christi, TX, to review the health risks associated with power line radiation. In a report submitted in March, Graves concluded that adverse public health effects "have not been established."

Area residents were not appeased. Led by Ian Macmillan of both the Collingwood Community Health Center (CCHC) and the Collingwood Residents Association (CRA), they charged that Graves's report is biased: "From the evidence available to us, it appears that Dr. Graves *is* aligned to one side of a now highly polarized debate, and should not hold such an influential position in this case."

The proposed line would replace an existing 66 kV line and would generally follow the present route through several communities in the Yarra River and Merri Creek valleys. In a 1 km stretch through a populated area, it would be placed underground. Also, the line would cross public school grounds. Last fall, concerned parents stepped up their opposition to the project when they learned of the $25 million award against Houston Lighting and Power Co. (HL&P) for siting a power line on school property (see *MWN*, November/December 1985).

In June, CCHC and CRA flew in Dr. Jerry Phillips of the Cancer Therapy and Research Foundation in San Antonio, TX, to rebut Graves's testimony. Phillips had testified at the HL&P trial.

The final decision on whether to build, delay or abandon the line lies with Robert Fordham, the Victoria Minister for Industry, Technology and Resources. He is expected to make an announcement in August.

Graves's report, *A Review of the State Electricity Commission of Victoria (SECV) Transmission Line and Station Design Practices in Relationship to the Health and Safety Effects on People*, was submitted to David White, the Victoria Minister for Health.

DoD's TEMPEST Program Badly Run, GAO Reports

Poor management of the Department of Defense's (DoD) TEMPEST program has resulted in millions of dollars of unnecessary expenditures and may have led to the disclosure of classified information, according to the General Accounting Office (GAO), a congressional investigative office.

The TEMPEST program, intended to protect classified electronic information, uses special shielding to prevent the unauthorized reception of stray radiation signals. The annual cost of TEMPEST is unknown, but GAO estimates that it is hundreds of millions of dollars.

In its new report, GAO found that DoD "often" failed to evaluate the need for TEMPEST measures, leading the department, in some instances, to "spend more money than necessary to protect classified information." Conversely, the lack of evaluations "could also result in insufficient protection being given to classified information."

A GAO spokesperson told *Microwave News* that it found no evidence of actual leaks.

GAO also charged that the Air Force, the Army and the Navy have been "slow" to implement security procedures issued in 1984 (see *MWN*, September 1984): As of June

1986, none of the three services had fully implemented the January 1984 National Communications Security Instruction (NACSI) 5004, which sets out TEMPEST procedures. In addition, GAO said that the services had administered the procedures separately and inconsistently and that all three had "usually" failed to inspect contractors' equipment to ensure TEMPEST compliance.

Enforcement Inadequate

Enforcement of TEMPEST requirements in DoD contracts is inadequate, GAO concluded. DoD's Defense Investigative Service (DIS), which is authorized to inspect contractors' facilities, cannot disapprove a system for TEMPEST violations. Instead, DIS must notify DoD contracting officers, some of whom do not know that they are responsible for enforcement and consequently fail to act when notified.

GAO recommended that the Secretary of Defense implement a new TEMPEST-related security policy and consider consolidating enforcement in a single office.

The report, *DoD TEMPEST Protection: Better Evaluations Needed to Determine Required Countermeasures,* was prepared for Congressman Glenn English (D-OK), chairman of the subcommittee on government information, justice and agriculture of the House Committee on Government Operations. A subcommittee spokesperson said that Congressman English is not planning hearings or any other follow-up work.

NSA Objection

The National Security Agency (NSA), which manages TEMPEST-related activities for DoD, objected to the release of the study but did not place a security classification on it. According to GAO, NSA "believes that, although not technically classified, this report contains 'extremely sensitive information, which, if made public, would be detrimental to the United States Government TEMPEST program.'" The subcommittee spokesperson told *Microwave News* that Congressman English had requested an unclassified report.

Vernon Microwave Radiation Levels in Picowatt Range

The residents of Vernon Township, New Jersey, are exposed to "significantly lower levels" of electromagnetic fields than most Americans, according to the Environmental Protection Agency (EPA). In measurements taken last November, EPA found that the average radiation levels were approximately 226 picowatts per centimeter squared (pW/cm^2), or 226 x 10^{-6} uW/cm^2, and, at some sites, the levels were below the detection limits of the measurement equipment. The maximum reading in the town was 2,810 pW/cm^2.

Vernon has been the center of a continuing controversy after a cluster of Down's Syndrome cases was identified among babies born to local residents (see *MWN,* May 1985). Citizens Against the Tower (CAT), a Vernon citizen's group, blames the cluster on exposures to microwaves because of the high concentration of radiation sources in the town: there are three satellite stations in Vernon with more than 15 uplink antennas and numerous point-to-point transmitters.

The highest radiation level measured by EPA was 60 uW/cm^2 in the 6 GHz band on a hillside on RCA property near its satellite station. EPA found that the power density fell to less than 10 uW/cm^2 beyond 650 feet from the antenna. New Jersey has a 5,000 uW/cm^2 standard at this frequency.

According to EPA, the measurements have an uncertainty of up to 3 dB — that is, they could be either too high or too low by a factor of 2.

CAT criticized the report for failing to provide a complete survey of the radiation pattern in the town. "They did not do what was necessary," CAT's Elise Kreindler said in an interview. "The report does not in any way begin to answer the question of disease pattern and its possible linkage to microwaves."

In its report, EPA admits to having done less than CAT had originally asked: "Inclement weather (rain, sleet, snow, icy roads) and time constraints limited the number of community measurement sites to 25."

In an "Analysis" of the EPA report, Dr. Robert Becker and Adam Becker called the results "completely inadequate" and the report itself "significantly flawed." They were especially critical of the limited number of measurements: "It is rather like taking thimblefuls of dirt from 25 randomly selected areas at Love Canal to assess the chemical contamination in the entire area." Robert Becker is the author of *The Body Electric: Electromagnetism and the Foundation of Life.*

Sidelobes Missed?

One of the unexpected findings in the EPA report is a power density of 2,810 pW/cm^2 in the 11 GHz band measured at the Rolling Hills Primary School, located near the American Satellite facility. This reading, EPA believes, was due to a terrestrial point-to-point relay.

The Beckers attributed the reading to a side lobe from a low power relay, which indicated to them that there must

Our Electrical Environment

Fifty to 100 lightning bolts hit the earth every second, killing hundreds of people each year, causing forest fires, threatening aircraft and damaging sensitive electronic equipment. They are the leading cause of power failures, such as the one that blacked out New York City in 1977.

Lightning is the most obvious manifestation of our complex electrical environment, which extends from the million amp currents that flow in the upper atmosphere down to the telluric currents in the oceans.

What we know about all this — and what we don't — is the subject of a new, major report by the National Academy of Science-National Research Council's Geophysics Study Committee. *The Earth's Electrical Environment,* a 263-page, well-illustrated volume, consists of 16 chapters, written by leading researchers in the field. It is available for $26.95 from the National Academy Press, 2101 Constitution Ave., NW, Washington, DC 20418.

be side lobes from the higher power earth stations, which EPA failed to identify due to its limited survey of the town.

Dr. Jeremy Raines, a consultant based in Potomac, MD, also voiced concern over the possibility that, in light of the 2,810 pW/cm² reading, EPA may have missed sites with higher power densities. In a letter to CAT, Raines contrasted what he called "very strong" signals from the satellite dishes with the contention, voiced at Vernon town hearings, that they were imperceptible or unmeasurable.

Advisory Committee

The radiation measurements were prompted, in part, by a November 1985 recommendation from the Centers for Disease Control (CDC) in a report confirming the existence of a Down's Syndrome cluster (see *MWN*, November/December 1985). CDC also advised the state's Department of Health to set up a scientific advisory panel with representatives selected by the state and by CAT.

The panel is expected to hold its first meeting in August. CAT has selected Dr. Ruey Lin of the Maryland Department of Health and Mental Hygiene to be its nominee to the panel. The New Jersey Bureau of Radiation Protection will be represented by Ron Peterson of AT&T Bell Labs.

As the microwave debate continues, Vernon has been faced with another radiation controversy. The state Department of Environmental Protection has selected the town for the burial of 5,000 drums of radon-contaminated soil. Vernon Mayor Victor Marotta was quoted by UPI as telling 5,000 protesters that local officials "will do what they have to do" to block the shipment. The town is in the process of appealing the decision in the state courts.

A copy of the EPA report, *An Investigation of Microwave and Radiofrequency Radiation Levels in Vernon Township, New Jersey, November 10-16, 1985,* June 1986, is available from Debby Wenke, Bureau of Radiation Protection, 380 Scotch Road, Trenton, NJ 08628, (609) 530-4003.

FROM THE FIELD

Wertheimer and Leeper: Estimating ELF Exposures

Reprinted below is a May 29th memo by Ed Leeper and Dr. Nancy Wertheimer on the Necessity for Taking Representative Magnetic Field Measurements in the Study Locale Before Using Wiring Configuration as an Indicator of Field Exposure for an Epidemiological Study.

This memo was prompted by the use of the Leeper-Wertheimer coding scheme by researchers in Europe. For a copy of Leeper's memo on Details of Wiring System Features with Particular Reference to U.S./European Differences, *send a self-addressed, stamped envelope to Leeper, Salina Star Route, Boulder, CO 80302.* *See also story on p.4.*

Since we published, in 1979, our first work linking cancer incidence with "wiring configuration," we have been pleased to see several other research groups using similar methods to study the epidemiology of ELF magnetic fields. We feel that wiring configuration is a fruitful way to assess long-term ELF magnetic field exposure in the home environment. Perhaps it is even the "best" or "only" way, especially when what is needed is to assess exposure at some past time.

However, we have been disturbed to see instances where the wiring configuration technique has been used without sufficient attention to the difficulties that may be expected.

The central problem is that *production of significant ELF magnetic fields by the electrical distribution system or home wiring is extremely dependent on details of that distribution system or home wiring.* Within one geographical area there can be enough standardization of wiring practices (because of building codes and the presence of only a single electric utility) to allow a statistically valid link to be discovered between easily determined physical features of the distribution of home wiring systems and the expected level of long-term ELF magnetic field exposure in the home. But wiring practices in another geographical area may be sufficiently different to require establishing that link all over again in a new way.

As we travel, even within this country, we are struck by how differently electrical distribution is implemented by power companies in different areas. But in *other* countries, the differences that we understand to exist are enormous — particularly in the all-important area of grounding practices.

In addition, several examples have come to our attention of home wiring practices used in other countries that are different from those used here and that would or could cause fields from home wiring to dominate the field exposure in the home.

Within the U.S., uniform wiring codes would seem to assure that other workers will find what we did: that wiring within the home rarely contributes substantially to the general magnetic field exposure within that home. But that hypothesis should not be assumed to be true in another country, without testing.

In any case, wherever work is done, *it is essential to take representative magnetic field measurements to establish a link between physical features ("configuration") and expected magnetic field exposure that will be valid for the locale in which the epidemiological research is to be done.* That point cannot be overemphasized.

Our own work has from the beginning included a program of measurements to identify physical features typically associated with elevated magnetic fields. For a variety of reasons, we find that this cannot be done by theory alone.

It was perhaps a mistake on our part that in our early publications on wiring configuration we did not (for reasons of space) emphasize the measurement-based empirical procedure we used to determine the particular wiring configurations we chose to compare with cancer rates. That was partly because at that time we took the conservative position that we had determined an apparent link only between certain wiring configurations and cancer. We were perhaps being overly cautious in doing that, since in fact those configurations were selected for their typical production of high magnetic fields.

In any case, seven years later and thanks to a variety of related work, the hypothesis to be tested is now rather clearly one of whether magnetic field exposure per se is linked to cancer. And that can be done using wiring configuration or the presence of other physical features only if representative measurements are taken in the locale of the study to determine what physical features are associated, *in that locale,* with elevated magnetic fields. Big wires don't always make big fields, and relatively small wires can make surprisingly strong fields in certain situations. In addition, especially outside the U.S., fields from wiring source[s] within the home may "swamp out" fields from outdoor distribution system wiring.

UPDATES

BIOLOGICAL EFFECTS

Calming with Microwaves... Pulsed microwaves at power densities as low as 50 uW/cm² can decrease aggressive behavior in rats, according to Drs. Allan Frey and Jack Spector of Randomline, Inc., in Huntingdon Valley, PA. In a paper scheduled to appear in the June issue of *Aggressive Behavior* (Vol.12, No.4), Frey and Spector report that rats exposed to 1.3 GHz radiation with a pulse width of 0.5 msec, a repetition rate of 1,000 pps and average incident power densities of 50 and 100 uW/cm² were significantly less likely to assault other rats, as measured by a well-defined method for quantifying aggressive behavior. Exposures at 20 uW/cm² did not affect the rats. Frey and Spector also found that the "pulse width did not appear to be critical." The results are consistent with Frey's hypothesis that low intensity electromagnetic energy can influence the dopamine-opiate systems in the brain (see *Journal of Bioelectricity, 3,* pp.373-383, 1984).

Induced Currents at 3-60 MHz... In our July/August 1985 issue, we reported on the latest research by Professor Om Gandhi and coworkers at the University of Utah in Salt Lake City showing that exposure to radiation in the 3-60 MHz band, at levels allowed under the 1982 ANSI safety standard, can result in high SARs and large currents flowing through the ankles and feet of barefoot individuals. These results have now been published in the August 1986 issue of the *IEEE Transactions on Biomedical Engineering.* Gandhi writes that, "The highest foot current for a 1.75 m human adult is observed at about 40 MHz with a value on the order of 12.7 mA/(V/m)." At 40 MHz, the ANSI standard is 61.4 V/m (1 mW/cm²), which would result in a 780 mA foot current and an SAR of 243 W/Kg in the ankles. For five- and ten-year-olds, the maximum ankle SARs are 534 W/Kg at 62.5 MHz and 371 W/Kg at 50.7 MHz, respectively. (ANSI specifies a maximum partial-body SAR of 8 W/Kg. See the report on the ANSI subcommittee's deliberations on this new data on p.6.) Gandhi's team also studied the currents induced from working at RF sealers. Douglas Hill and Alan Walsh of the Defense Research Establishment in Ottawa have estimated lower SARs through the ankles (see "Radiofrequency Current Through the Feet of a Grounded Human" in the February 1985 *IEEE Transactions on Electromagnetic Compatibility.)* Gandhi ascribes the Canadians' low values to their overly simplified model of the human ankle.

COMPATIBILITY & INTERFERENCE

Ovens and DBS... Direct broadcast satellites (DBS) promise to change the way people tune in television signals, especially in Europe and Japan, but their reception may be hurt by another household appliance, the microwave oven. Most ovens now operate at 2.45 GHz, and emissions of their fifth harmonic could therefore interfere with downlink satellite transmissions in the 12 GHz band. A team from Hitachi's Mobara Works in Japan has been studying ways of suppressing emissions from an oven's magnetron by fitting a choke to its output antenna. In a paper presented at the *21st Annual Microwave Power Symposium* in Memphis, TN, at the end of July, Akikazu Harada and coworkers indicated that they have succeeded in reducing the fifth harmonic by 20 dB and predicted that their suppression methods will soon be incorporated in the mass production of magnetrons for ovens; this and more may be necessary if new, stringent limits are adopted for ISM equipment. They pointed out one tradeoff, however: reducing the fifth harmonic can result in higher emissions of other harmonics. An abstract of their paper appears in the *Journal of Microwave Power, 21,* p.90, 1986.

ARRL Petition Denied... The FCC has turned down the American Radio Relay League's (ARRL) April 22 request for mandatory EMI susceptibility labeling of home electronics equipment (see *MWN,* March/April 1986). In rejecting the ARRL's petition, FCC Chief Engineer Thomas Stanley reasoned that determining which of two labels to apply — one for equipment with EMI controls and one for equipment without — would require the FCC to develop and implement EMI susceptibility standards. The FCC has decided instead to maintain its position of "minimum regulatory involvement," relying on manufacturers to comply with voluntary guidelines. The ARRL has already filed a petition for reconsideration.

The Long Electronic Arm of the Law... Captain Midnight, the video vandal who overrode a Home Box Office (HBO) movie in April to protest the network's decision to scramble its signals, has been caught. The FCC got its man — John MacDougall, a 25-year-old Floridian who owns a satellite dish sales company — with the help of some electronic sleuthing. Because only a handful of the 2,000 U.S. satellite uplink stations are large enough and powerful enough to override the HBO signal, and because only a few have the right type of character generator, federal sleuths narrowed their search to less than a dozen sites. Then, with the help of a hot tip from an overheard telephone call, they narrowed in on the Central Florida Teleport at Ocala. MacDougall surrendered on July 22 and plea-bargained a sentence of one-year unsupervised probation and a $5,000 fine. HBO Chairman Michael Fuchs, obviously satisfied with the FCC's feat, warned that his company has taken "certain precautions" to discourage future video intruders. Nevertheless, satellite experts have a whole new set of worries: What, they ask, if a terrorist could order a satellite to leave its orbit and get lost in space?

Supersecret EMI... In Key West, FL, several would-be broadcasters trying to start a TV station on channel 3 have met stiff opposition from the Navy, according to the July 18 *Wall Street Journal.* The Navy apparently operates a communications center on the island, but it is so secret that the Navy refuses to even discuss the facility, except to say that the TV signals would interfere with it. Some people speculate that the base is a listening post for signals from Cuba. After meeting with the Navy, the FCC suggested that the station move to channel 8. To enable such a change, however, an educational station 60 miles away in Marathon, FL, would have to switch from channel 9 to channel 3.

New on the Market... KeyTek Instrument Corp. has developed two new surge generators (Models 587 and 587-Plus) for simulating AC power line transients to comply with ANSI C62.41-1980. The units, which cost $19,870 and $22,935, respectively, are described in the company's Bulletin

587/1, available free from Mike Hopkins, KeyTek Instrument Corp., 12 Cambridge St., Burlington, MA 01803, (617) 272-5170...The Southwest Research Institute (SwRI) in San Antonio, TX, has built a 16x16x28-foot anechoic chamber for EMI testing at frequencies as low as 30 MHz. For more information, contact William McGinnis, manager, SwRI EMC Services, 6220 Culebra Rd., PO Drawer 28510, San Antonio, TX 78284, (512) 684-5111...Amplifier Research has a new high-power horn antenna designed to reduce the problem of field strength loss at high frequencies. Model AT4001, which can operate in the frequency range 400-1,000 MHz, with an input power of up to 1,000 watts, is designed for shielded-room and open area RFI susceptibility and emission testing. The unit costs $2,000 and is available from Amplifier Research, 160 School House Rd., Souderton, PA 18964, (215) 723-8181...Electro-Metrics has improved its TEMPEST Test Receiver. The new NTR-51C is faster, lighter and smaller than the old NTR-51, while meeting or exceeding the requirements of NACSIM 5100A. Contact: Electro-Metrics Marketing Dept., 100 Church St., Amsterdam, NY 12010, (518) 843-2600...And, Systematics General of Vienna, VA, has adapted an Apple Macintosh computer to comply with TEMPEST standards. According to the announcement in the July 28 *InfoWorld,* the TEMPEST shielding increases the weight of the Macintosh from 17 to 26 pounds.

MEASUREMENT

New from NBS...Here are some of the latest reports and papers from the National Bureau of Standards...From their Technical Note series: • *A Radiofrequency Power Delivery System: Procedures for Error Analysis and Self-Calibration,* by Motohisa Kanda and R. David Orr (TN 1083). Order No. 003-003-02610-1, $1.00, prepaid, from U.S. Government Printing Office (GPO), Washington, DC 20402. • *Site Attenuation,* by R.G. FitzGerrell (TN 1089). Order No. 003-003-02708-1, $2.00, prepaid, from GPO. • *Interelement Interactions in Phased Arrays: Theory, Methods of Data Analysis, and Theoretical Simulations,* by Lorant Muth (TN 1091). Order No. 003-003-02715-4, $2.00, prepaid, from GPO. • *Direct Measurement of the Electric Field of a Laser Pulse — Theory,* by Eric Johnson, Jr. (TN 1084). Order No. 003-003-02697-2, $2.25, prepaid, from GPO...Recent bibliographies and compilations: • *Metrology for Electromagnetic Technology: A Bibliography of NBS Publications,* edited by Kathryn Kline and Mary DeWeese (NBSIR 85-3029). Order No. PB 86-130234, $11.95, prepaid, from National Technical Information Service (NTIS), Springfield, VA 22161. • *A Bibliography of the NBS Electromagnetic Fields Division Publications,* edited by Kathryn Gibson, Jessie Page and Charles Miller (NBSIR 85-3040). Order No. PB 86-191947, $11.95, prepaid, from NTIS. • *Precision Measurement and Calibration: Electricity,* edited by A.O. McCoubrey (SP 705). Order No. 003-003-02699-9, $23.00, prepaid, from GPO....New near-field publications: • *Development of Near-Field Test Procedures for Communication Satellite Antennas, Phase I, Part 1,* by Allen Newell and Andrew Repjar (NBSIR 85-3031). Order No. PB 86-1643577, $11.95, prepaid, from NTIS. • *An Efficient and Accurate Method for Calculating and Representing Power Density in the Near-Zone of Microwave Antennas,* by Richard Lewis and Allen Newell (NBSIR 85-3036). Order No. PB 86-181963/AS, $9.95, prepaid, from NTIS....Also of interest: • *Out-of-Band Response of Reflector Antennas,* by David Hill (NBSIR 85-3021). Order No. PB 85-224475/AS, $11.50, prepaid, from NTIS. • "Simple Approximate Expressions for Higher Order Mode Cutoff and Resonant Frequencies in TEM Cells," by Perry Wilson and Mark Ma in *IEEE Transactions on Electromagnetic Compatibility, 28,* pp.125-130, 1986.

MEDICAL APPLICATIONS

Pacemaker EMI...RF interference from a magnetic resonance imaging (MRI) scanner operating at 0.5 tesla caused total inhibition of atrial and ventricular output in three DDD pacemakers and dangerous atrial pacing in a fourth unit, according to Dr. Jay Erlebacher and his coworkers at the New York Hospital-Cornell Medical Center in New York City. In their paper, which appears in *The American Journal of Cardiology, 57,* pp.437-440, 1986, they conclude that "MRI scanning should be avoided in patients with implanted DDD pacemakers."

MEETINGS

BRAGS in Holland...The program for the *6th Annual Meeting of the Bioelectrical Repair and Growth Society (BRAGS)* has been finalized and it promises an international cast. Researchers from Belgium, Bulgaria, England, Israel, Italy, Poland, the Soviet Union, Sweden, West Germany, Yugoslavia, as well as from the U.S. and Canada, are scheduled to present papers in Utrecht, Holland, October 19-22. Special rates at the official conference hotel (Holiday Inn) will be available until September 1. And KLM is offering special airfares: in the U.S., contact Gerda Cooper at Rosenbluth's Travel, (800) 233-3158; elsewhere, contact KLM directly and mention BRAGS.

IRPA-7 in 1988...Non-ionizing radiation, usually the poor relation to ionizing radiation, is slowly gaining respect. At the *7th International Congress of the International Radiation Protection Association (IRPA)* to be held in Sydney, Australia, April 10-17, 1988, many of the sessions will address both types of radiation — the first time in IRPA history that they will be considered together. The week before the congress (April 5-8), there will be a workshop on *Non-Ionizing Radiation Biological Effects, Protection and Standards* in Melbourne. This review session will cover all types of non-ionizing radiation from ELF to microwaves to UV to IR and visible light, as well as lasers. The overall theme of the congress will be "Radiation Protection Practice." Papers are now being invited for oral and poster presentations, with abstracts due by March 15, 1987. For more information on both IRPA-7 and the workshop, contact J.C.E. Button, Health and Safety Division, Australian Atomic Energy Commission, Private Mail Bag, Sutherland, NSW 2232, Australia.

Complying with RF Broadcasting Rules...The National Association of Broadcasters (NAB) is sponsoring a one-day seminar on how to comply with RF radiation regulations at the *Radio'86* convention in New Orleans, LA. The September 10 seminar will cover the FCC rules, measure-

ment techniques, FM antenna patterns, occupational exposures and tower maintenance, as well as "dealing with *zoning commissions" and "public inquiries and the press."* The speakers will be: Jules Cohen, Robert Culver, Thomas Fitch, Ralph Justus, Ronald Rackley, Ruth Rosenberg, Richard Tell and Barry Umansky. Registration costs $150 for NAB members and $250 for others. Those attending *Radio'86* can save $100. For more information, contact NAB's Dept. of Science and Technology, 1771 N St., NW, Washington, DC 20036, (202) 429-5346.

MILITARY SYSTEMS

EMPRESS II Developments...The Navy has reported further delays in preparing a supplemental draft Environmental Impact Statement (EIS) on its second Electromagnetic Pulse Radiation Environment Simulator for Ships (EMPRESS II). Already more than a year overdue, the report is now scheduled for release in November; following public review, it will be revised, with the final EIS due next April, according to a Navy spokesman. The Navy, which plans to site EMPRESS II on Chesapeake Bay in Maryland, met with state officials on July 17 as part of a continuing series of discussions on its biological monitoring program. The NAVY plans to have EMPRESS II operational in 1990.

OVENS

Burn Injuries...As microwave ovens continue to grow in popularity, more and more burns will result from their misuse, warns a researcher at the Shriners Burns Institute in Cincinnati, OH. The results of a three-nation (U.S., U.K. and Canada) survey indicate that the most frequent cause of injury from microwave ovens is scalding by hot liquids or vapors — in particular, infants are injured by overheated baby bottles. "Haste and an attitude that microwave ovens *are safer...result in injury," explains Dr. Matthew Maley.* Oven manufacturers, he notes, do not include warnings about bottle burns in operating manuals and, although bottle manufacturers do warn of such dangers, many parents nevertheless heat bottles in their microwave ovens. Other causes of injuries include exploding eggs, contact with hot items and exposure to microwaves when ovens fail to shut off after their doors are opened. An 11-page report on Maley's survey findings is available from Risk Management, Shriners Burns Institute, 202 Goodman St., Cincinnati, OH 45219. A letter based on the report appeared in the May 17th issue of *The Lancet.*

Hot Scoop...The Milwaukee-based Johnston Company has done it again. Years ago it was the first commercial producer of fudge. Now, after two years of R&D, it has produced what many thought would be impossible: the microwave-able hot fudge sundae. Hot on the outside and cold on the inside, the "Hot Scoop" can go from the freezer to your lips in only 30 seconds. The sundae, available in chocolate, mint fudge and caramel, is being test-marketed in a few states and may soon be in a store near you. Can Baked Alaska be far behind?

PEOPLE

In October, Dr. **Tom Rozzell** will leave his post as manager of the Bioelectromagnetics Program at the Office of Naval Research (ONR) to become the assistant director of the Associateship Program at the National Research Council-*National Academy of Sciences. Starting 15 years ago with* a budget of only $50,000, Rozzell built the ONR program into a major source of funds for basic research — an area otherwise neglected by other federal agencies — and in 1978 he was instrumental in founding the Bioelectromagnetics Society. At the NAS-NRC, Rozzell will administer postdoctoral awards for young scientists in the life sciences at federal labs across the country. A search for his replacement at ONR is underway...Professor **Herbert Pohl** died of a heart attack on June 21 at the age of 70. Pohl taught in the Department of Physics at Oklahoma State University from 1964 to 1981 and was a visiting scientist at MIT at the time of his death. Pohl is best known for his research on the natural oscillating fields associated with living cells. He is the author of *Dielectrophoresis: The Behavior of Matter in Non-Uniform Electric Fields* (Cambridge University Press, 1978) and was the editor of the *Journal of Biological Physics.*

POWER LINES

No DC Risks in Minnesota...The majority on an expert advisory panel to the Minnesota Environmental Quality Board (MEQB) has reaffirmed its conclusion that a ±400 kV DC power line poses no risk to public safety. Six members of the panel, which first declared the line safe in December 1982, found that none of the studies appearing in the literature in 1983 and 1984 contradicted their assessment (see *MWN,* January/February 1984). The lone dissenter, Dr. Robert Brambl of the University of Minnesota in Minneapolis-St. Paul, did not participate in the recent review, telling the MEQB that the new report supported his 1982 position "...that it is more likely than not that the line represents a potentially significant hazard to human and *animal health." The majority opinion, presented in the* MEQB's report, *Comments of the MEQB Science Advisors on Electrical Environment Outside the Right of Way of CU-TR-1, Report 5,* is that "There still appears to be little likelihood that either chronic or acute exposure to small air ions and static electric fields at levels measured either on or downwind of the right of way of the DC line cause adverse health effects." The board issued *Report 5* in May 1985 as the final annual report in its five-year review of possible hazards from the Minnesota section of the Cooperative Power Association-United Power Association line, which also crosses part of North Dakota. In another report, the MEQB reported that its reanalysis of data on milk production, calving intervals and culling rates among cows living near the line supported an earlier analysis that found no significant effects. The report, *DHIA Bovine Performance and the DC Power Line,* includes more complex statistical analysis than the initial report presented, and it recommends against further study of cows. For more information, contact George Durfee of the Minnesota State Planning Agency, 100 Capitol Square Bldg., 550 Cedar St., St. Paul, MN 55101, (612) 296-2878.

STANDARDS

Power Line Noise...The International Special Committee on Radio Interference (CISPR) has released *Radio Inter-*

ference Characteristics of Overhead Power Lines and High Voltage Equipment. Part 3: Code of Practice for Minimizing the Generation of Radio Noise (Publication 18-3, 1986). The standard addresses (1) the design of power lines to control EMI to radio and television reception in the 150 kHz-300 MHz frequency range; (2) a method of predicting noise levels with a simple formula, and (3) ways of detecting and fixing loose and imperfect contacts that can spark and generate noise. It is available for $37.00 (including postage and handling) from the American National Standards Institute (ANSI), 1430 Broadway, New York, NY 10018, (212) 354-3300. *Part 2: Methods of Measurement and Procedure for Determining Limits* is due out later this year. *Part 1: Description of Phenomena* was released in 1982 and can be purchased from ANSI for $79.00, plus 7% for postage and handling....The revised version of the ANSI-IEEE 1976 standard on *Procedures for the Measurement of Radio Noise from Overhead Power Lines and Substations* (ANSI/IEEE 430-1986) was approved for publication earlier this year and should be available from ANSI soon.

ETC. . .

Summer Reading...Best-selling author and *New York Times* writer Jane Brody devoted her July 23 "Personal Health" column to the safety of microwave ovens. Her first paragraph reflects the changing attitudes toward this best-selling appliance: "Ten years ago, when my husband wanted to give me a microwave oven for our anniversary, I asked him if he was trying to get rid of me. Last Christmas, however, I bought one myself."...Veteran *Aviation Week* reporter Philip Klass has written a fascinating history of electronic warfare — see "Radar Countermeasures" in the August issue of *High Technology*....Jammers are finding a market among highway speeders, who want to confuse Smokey's radar gun. Such devices are illegal, expensive and, according to tests run by *Car and Driver* (April 1986), they don't work. The magazine recommends that those who want to go faster than 55 miles per hour should "stick with a reliable radar detector, a level head, quick reflexes and a keen pair of eyes." Certainly, sales of radar detectors continue to boom. According to an item in the July 7 *Time* magazine, 1.5 million people bought them last year, a 25% increase over 1984. A story in the August 1 *Wall Street Journal* quotes the president of Cincinnati Microwave, a leading manufacturer of radar detectors, as saying that most of his sales come on Mondays, after drivers have been nailed over the weekend....COMSAT's J.V. Evans presents a review of "Twenty Years of International Satellite Communication" in the July/August issue of *Radio Science*.

Tumor Cells in ELF Fields *(continued from p.1)*

Phillips's tumor cell studies, carried out with equipment supplied by the New York State Power Line Project, have been the object of much speculation and controversy since preliminary data were disclosed two years ago by Dr. Wendell Winters, who set up the exposure system in his lab at the University of Texas Health Science Center in San Antonio (see *MWN,* April and September 1984).

A 1984 site visit report by New York state officials raised a number of concerns about how to interpret Winters's early statements (see *MWN,* November 1984). Some of those concerns persist today. Recently, Dr. Michael Shelanski of the New York University Medical School told *Microwave News,* "I don't think I can draw any conclusions, pro or con, about implications [of the studies] on the health effects of power line fields." Shelanski, who is the chairman of the New York project's Scientific Advisory Panel, questioned the large variations in the numbers of colonies among both the exposed and control cells — one of the major criticisms cited in the 1984 site visit report.

Phillips distanced himself from Winters's 1984 statements. Addressing the variability in colony formation, Phillips countered that unexposed (control) cells did not show that much variation. "Look at the published data," he said. The variation among the exposed cells is not all that surprising, he continued, because "we don't yet know why the cells are sensitive to EMF fields."

Proliferation and Immunity

In the first set of experiments, Phillips and coworkers exposed two lines of human colon tumor cells (Colo 205 and Colo 320 DM) to 60 Hz electric (300 mA/m²) and magnetic (1.0 gauss) fields, singly and in combination, for 24 hours. Examination of the cells 7-14 days later revealed that the combined electric and magnetic fields and the magnetic field alone had significantly enhanced the number of tumor cell colonies. Also found were increased levels of tumor-associated antigens on the cells' surface. The cells exposed only to the electric field showed mixed effects.

Because the cells underwent a number of divisions over the course of the two-week experiment, the researchers suggest that the changes induced by the EMFs "are permanent and involve, therefore, an alteration of the cell's genetic information."

Next, in order to explain why the cells flourished in the field, the researchers studied how the same EMFs affected the number of transferrin receptors on their surface. Transferrin is a protein which transports iron and other metals through the cell membrane by binding to surface receptors; the number of receptors has been associated with cell proliferation.

Four, six and eight months after the same type of 24-hour exposure to the combined fields and to the magnetic field alone, cells had more transferrin receptors — approaching or exceeding the maximum possible number predicted by theoretical models. The ability of transferrin to bind with its receptor was unchanged. Those cells exposed only to the electric field, on the other hand, had fewer receptors than expected.

Here again, the exposed cell colonies multiplied prodigiously — up to a 24-fold increase relative to controls — and continued to do so eight months after exposure.

The normal regulatory systems had clearly stopped func-

tioning. Phillips's team again concluded that the EMFs had caused some basic and permanent change in the way the cells functioned.

In the third series of experiments, they examined the ability of human lymphocytes (natural killer cells) to destroy the EMF-exposed tumor cells, and they unexpectedly found that destruction of electromagnetic and magnetic field-exposed tumor cells "dramatically decreased."

Previous studies have indicated a relationship between the number of transferrin receptors and susceptibility to attack by lymphocytes, and so it is not clear why the cells with the largest number of receptors did not succumb to the lymphocytes. Nevertheless, their immunity enhances the general ability of the tumor cells to thrive after EMF exposure, further supporting the role of magnetic fields in cancer promotion.

Replication Underway

Dr. Maimon Cohen of the University of Maryland School of Medicine in Baltimore has begun work on a replication study of these experiments under a grant from the New York State Power Line Project. The project had originally asked Dr. Gordon Livingston of the University of Utah in Salt Lake City to attempt the replication (see *MWN*, October 1984) but, according to Shelanski, that study did not work out.

References

Jerry L. Phillips, Wendell D. Winters and Loyce Rutledge, "*In Vitro* Exposure to Electromagnetic Fields: Changes in Tumor Cell Properties," *International Journal of Radiation Biology, 49,* pp.463-469, 1986.

Jerry L. Phillips, Loyce Rutledge and Wendell D. Winters, "Transferrin Binding to Two Human Colon Carcinoma Cell Lines: Characterization and Effect of 60 Hz Fields," *Cancer Research, 46,* pp.239-244, 1986.

Jerry L. Phillips, "Transferrin Receptors and Natural Killer Cell Lysis: A Study Using Colo 205 Cells Exposed to 60 Hz Electromagnetic Fields," *Immunology Letters* (in press).

Workers Claim Radar Accident *(continued from p.1)*

OSHA Could Not Substantiate Accident

A complaint was filed with the Occupational Safety and Health Administration (OSHA), but OSHA inspectors were unable to determine whether the radar had been turned on. William Masters, OSHA's area director for the state of Maine, said that no violation could be substantiated for radiation overexposure but a citation was issued for failure to post enough RF radiation hazard caution signs. During the same inspection, BIW was cited for not having a guardrail on one crane.

The citation for the lack of radiation signs does not entail a fine; the guardrail violation carries a $640 penalty. BIW did not contest either citation and will pay the fine, according to an OSHA spokesman.

Dennis Brillant, who was operating a crane and was at the same height as the radar, complains of lasting injuries and has not returned to work since the accident. Brillant referred questions about his condition to his attorney, Jonathan Reitman of Brunswick, ME, who did not answer requests for comment.

A source familiar with Brillant's condition told *Microwave News* that Brillant is often disoriented and that his short-term memory is impaired. Brillant has constant headaches and must take medication to dull the pain: "He is not the same man as he was before March 19," said the source, who requested anonymity. These symptoms are similar to those reported by the men involved in the radar accident at Clear Air Station in Alaska (see *MWN,* November 1983 and September/October 1985).

The Workers' Accounts

Notes written by two other crane operators describe how they felt at the time of the incident:

Joe Chagnon: "On March 19, 1986, around 7:10-7:15 [a.m.], I called my foreman and told him I was coming out of the crane and going to first aid, because I had a headache. When I got to first aid, my head felt like it was going to blow up. The nurse said my face and neck were bright red. She checked me out and said my blood pressure was up and [I had a high pulse rate and a] fever. First aid told me to go to the hospital...The doctor also took pictures of my neck and right shoulder."

Paul Gosselin: "About 07:20, I experienced a tremendous headache and a burning sensation about my face, eyes and neck. I also felt weird all over. This seem[ed] to come in a matter of minutes. It also set off alarms in the drydock. At about 07:45, I went to first aid where elevated blood pressure was detected and also rapid pulse..."

BIW Report Due

BIW is preparing a report on the March 19 incident. Jim McGregor, BIW's director of public relations, told *Microwave News* that the report would be released on August 12 – although he had said previously that it would be available the first week of July. Asked about the delay, he said, "We want to make absolutely certain that the radar functioned properly and that whatever medical problems were reported were not caused by the radar."

A March 21 internal BIW memorandum obtained by *Microwave News* states that tests of the SPS-49 radar carried out that day produced "no discernible readings" on a "RADHAZ" meter.

Local 6's Mackie said that he remembers another accident a few years ago. But McGregor said that previous allegations of radar exposures had proved negative.

Dr. Jennifer Christian, an industrial hygienist at BIW, called many experts on the health effects of radar radiation after the accident, but she declined to be interviewed for this article.

The Navy did not respond to requests for comment.

CONFERENCES

Upcoming Meetings

September 8-11: **16th European Microwave Conference,** National Concert Hall, Dublin, Ireland. Contact: Microwave Exhibitions & Publishers, Convex House, 43 Dudley Rd., Tunbridge Wells, Kent TN1 1LE, U.K.

September 11-13: **Scientific Conference on Electropathology,** Physiologisches Institut der Universitat Freiburg, Federal Republic of Germany (F.R.G.). Contact: Conference Secretariat, Forschungsselle fur Elekktropathlogie, Reutebachgasse 11, D-7800 Freiburg, F.R.G., (0761) 56201.

September 13-16: **39th Annual Conference on Engineering in Medicine and Biology,** Marriott Hunt Valley Inn, Baltimore, MD. Contact: Susan Leone, Suite 700, 1101 Connecticut Ave., NW, Washington, DC 20036, (202) 857-1199.

September 14-19: **1986 IEEE/PES Transmission and Distribution Conference and Exposition,** Convention Center, Anaheim, CA. Contact: Charles White, South Carolina Electric and Gas Co., PO Box 764, Columbia, SC 29218, (803) 748-3518.

September 16-18: **IEEE International Symposium on Electromagnetic Compatibility,** Town and Country Hotel, San Diego, CA. Contact: George Ufen, GRU Associates, 1105 East Commonwealth Ave., Fullerton, CA 92631, (714) 738-0903.

September 17-19: **International Utility Symposium on the Health Effects of Electrical and Magnetic Fields: Research, Communication and Regulation,** Constellation Hotel, Toronto, Ontario, Canada. Contact: John O'Grady, Ontario Hydro, Suite H8 D4, 700 University Ave., Toronto, Ontario M5G 1X6, Canada, (416) 592-3395.

September 17-19: **1986 Symposium on Antenna Applications,** Allerton House, Monticello, IL. Contact: Paul E. Mayes, Dept. of Electrical and Computer Engineering, University of Illinois, 1406 W. Green St., Urbana, IL 61801, (217) 244-0543.

September 21-24: **3rd Congress of the European Society of Magnetic Resonance in Medicine and Biology,** University of Aberdeen, Scotland. Contact: Dr. Margaret A. Foster, Dept. of Biomedical Physics and Bioengineering, University of Aberdeen, Foresterhill, Aberdeen AB9 2ZD, Scotland, U.K., (0224) 681818, ext.3208.

September 22-25: **8th European Hyperthermic Oncology Scientific Meeting,** Rehovot-Tiberias, Israel. Contact: Dr. A. Yerushalmi, Dept. of Cell Biology, The Weizmann Institute of Science, Rehovot 76100, Israel.

September 23-25: **8th Annual Meeting and Symposium of the Antenna Measurement Techniques Association,** Westin Hotel, Ottawa, Ontario, Canada. Contact: Laurier Forget, National Research Council, Ottawa, Ontario K1A 0R6, Canada, (613) 993-9009.

September 23-25: **8th Annual Electrical Overstress/Electrostatic Discharge Symposium,** Riviera Hotel, Las Vegas, NV. Contact: Michael Martin, 3M/Static Control Systems Div., 2111 W. Braker Lane, Bldg. 501, PO Box 2963, Austin, TX 78769, (512) 834-3117.

September 23-26: **Heating and Processing: 1-3000 MHz,** Cambridge, U.K. Contact: British National Committee for Electroheat, 30 Millbank, London SWIP 4RD, U.K.

September 29-October 3: **Montech'86: IEEE Week in Montreal,** Convention Center, Montreal, Quebec, Canada. Includes: Sept. 29-Oct. 2: **Conference on Antennas and Communications,** chaired by Dr. A. Kumar, (514) 457-2150; Sept. 29-Oct. 2: **Conference on HVDC Power Transmission,** chaired by Dr. P.C.S. Krishnayya, (514) 652-8342; Oct. 1-3: **Conference on AC Power Systems,** chaired by Gilles Baril, (514) 652-8212; Oct. 1-3: **Conference on Electrothermal Processes,** chaired by Edward Goodman, (514) 652-8546. General conference address: PO Box 37, Station "A," Montreal, Quebec H3C 1C5, Canada.

September 30-October 3: **5th International Conference and Tutorial Day on Electromagnetic Compatibility,** University of York, U.K. Contact: The Conference Secretariat, IERE, 99 Gower St., London WC1E 6AZ, U.K., (01) 388-3071.

October 6-7: **2nd International Conference on Harmonics in Power Systems,** Winnipeg, Manitoba, Canada. Contact: Robert Hamlin, Room 227, Engineering Bldg., University of Manitoba, Winnipeg, Manitoba R3T 2N2, Canada, (204) 261-4412.

October 6-12: **1st International School: Electromagnetic Fields and Biomembranes,** Pleven, Bulgaria. Contact: Professor Marko Markov, Dept. of Biophysics and Radiobiology, Sofia University, 8 Dragan Tzankov Blvd., Sofia 1000, Bulgaria.

October 14-16: **1st National Convention of the Society of Broadcast Engineers (SBE),** A.J. Cervantes Convention Center, St. Louis, MO. Contact: SBE National Convention, PO Box 16861, St. Louis, MO 63105, (314) 725-2184.

October 19-22: **6th Annual Meeting of the Bioelectrical Repair and Growth Society (BRAGS),** Utrecht, Holland. Contact: BRAGS, PO Box 64, Dresher, PA 19025, (215) 659-5180.

October 20-24: **11th IEEE International Conference on Infrared and Millimeter Waves,** Hotel Continental, Pisa, Italy. Contact: M. Inguscio, Dept. of Physics, University of Pisa, Piazza Torricelli 2, I-56100 Pisa, Italy, (050) 45222.

SUBSCRIBE NOW!

I want to subscribe to **MICROWAVE NEWS.**

☐ One Year (6 Issues)
$200 U.S., Canada; $235 Foreign

☐ Six Month Trial (3 Issues)
$105 U.S., Canada; $125 Foreign

I want to subscribe to **VDT NEWS.**

☐ One Year (6 Issues)
$87 U.S. Only; $97 Canada & Foreign

☐ Two Years (12 Issues)
$150 U.S. Only; $170 Canada & Foreign

☐ Payment Enclosed ☐ Bill Me

Name _____

Address _____

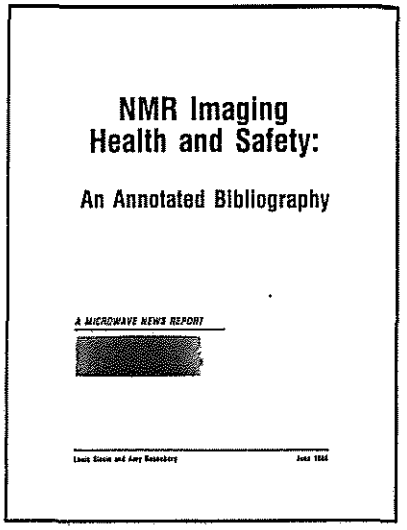
City _____

State _____ *Zip* _____

Make checks payable to: **Microwave News,** PO Box 1799, Grand Central Station, New York, NY 10163, (212) 517-2800.

CLASSIFIEDS

NMR Imaging Health & Safety



Order your copy of this annotated bibliography published by *Microwave News*. Only $18.95 (prepaid), PO Box 1799, Grand Central Station, New York, NY 10163.

RF Molecular Biologist

Non-ionizing, radiofrequency radiation molecular biologist with documented training and experience in the application of recombinant DNA techniques to the study of microwave bioeffects. Ph.D., or equivalent, in biochemistry or molecular biology and at least five years of research experience in the area. To develop, lead and conduct an experimental program directed towards elucidation of biophysical interaction mechanisms. Other responsibilities will include purifying viral and plasmid DNA, developing DNA probe systems and evaluating molecular medical device technologies. Additional training in physics, virology and immunology is highly desirable. Salary dependent on experience and to be negotiated. Send curriculum vitae and names of three references to: Larry Bockstahler, Ph.D., 12709 Twinbrook Parkway, Rockville, MD 20857, by Sept. 30, 1986. An Equal Opportunity/Affirmative Action Employer.

Order Back Issues at a Discount

Back issues of *Microwave News* are now available at a discount. Order all of our 1985 issues for just $95 ($100 outside the U.S. and Canada), *a savings of more than 50 percent.* Previous issues (1981-1984) are available for $75 per year. Order now!

The Journal of Microwave Power and Electromagnetic Energy

In the first two issues of Volume 21 (1986), now available:

The Development of Biomedical Approaches and Concepts in Radiofrequency Radiation Protection P. Czerski.

Exposure of Workers to Intense RF Electric Fields that Leak from Plastic Sealers M. Bini, A. Checcucci, A. Ignesti, L. Millanta, R. Olmi, N. Rubino and R. Vanni.

Increasing Antigenecity of B16 Melanoma Cell Fraction with Microwave Hyperthermia R. Santini, M. Hosni, T. Douss, P. Deschaux and H. Pacheco.

Thermometric Consideration for RF and Microwave Research in Food Engineering R. Ofoli.

***Temperature Controlled Combined Microwave/Convection* Drying** P.G. Jolly.

Symposium Summaries (46) on domestic, industrial, scientific, and medical applications of electromagnetic energy, biological effects and materials processing.

Current patents, reviews and news.

4 issues per year; back issues available; also in microfiche. 21-year index (1,100 papers and reviews) available August 1986. For information on these and other publications, and to order *The Journal of Microwave Power and Electromagnetic Energy,* write:

IMPI, 13542 Union Village Circle, Clifton, VA 22024 U.S.A. or telephone: (703) 830-5588 (Visa, Mastercard).

J. Microwave Power EE: U.S. $75/year in North America; elsewhere (by airmail), and all libraries: U.S. $80/year. Printed and published in Canada. Editor: Geoffrey Voss, Victoria, B.C.: (604) 384-1021.

MICRO WAVE NEWS

Vol. VII No. 4 | A Report on Non-Ionizing Radiation | July/August 1987

INSIDE...

HIGHLIGHTS pp.2-6

The Talk of BEMS
PMFs Again Linked to Abnormal Pregnancies in Mice
PMFs: Chromosomal Changes
DNA MW Absorption Contested
ANSI Too High? A Thermal View

ELF NEWS pp.6-10

Long-Term ELF Behavioral Effect
Two New EPRI Studies
NY State Power Lines Project:
- *List of Project Reports*
- *Summary & Recommendations (Full Text)*

NEW BOOKS pp.11-13

Invited Reviews
Briefly Noted

UPDATES pp.14-15

Portland, Oregon, To Vote on Exposure Standard • Boeing Meeting on EMP Bioeffects • NIEHS Stops In-House Research • Measuring VDT EM Fields • NAB Session on RF Compliance • US-USSR Cooperation Continues • EEPA Review of RF Effects • Protecting Medical Devices from EMP • Oven Leakage Increases with Age • Regulating Power Line Risks • Noise on Demand • Belgium's MW Oven Standard • Is 50 kV/m the Right EMP Threshold? • and more...

CONFERENCES p.10

New Listings
Upcoming Meetings

NY State Power Lines Report: ELF Risks Gain National Attention

The New York State Power Lines Project's scientific advisory panel has accepted and endorsed the findings of the Savitz study, noting that they add "to the credibility of the [Wertheimer-Leeper] hypothesis that exposure to extremely low frequency [ELF] magnetic fields might be a cause of childhood cancer."

In its final report, the panel distanced itself from endorsing a "causal relationship" between power line magnetic fields and cancer, however – arguing that it is "still no more than a hypothesis," albeit a "stronger" one now. If a causal relationship does exist, the panel estimated that "10-15% of all childhood cancer cases are attributable to magnetic fields."

While bemoaning the absence of a mechanism to explain the action of the magnetic fields, the panel underlined how small the implicated fields are: "One might be exposed to such fields almost anywhere in the environment."

Overall, the panel concluded that the 16 funded studies indicated a "variety of effects" not "previously appreciated" and that, "Several areas of potential concern for public health have been identified." One particular result that has sparked special interest is Dr. Kurt Salzinger's experimental finding of long-term behavioral effects from pre- and post-natal exposure to ELF fields (see p.6). The panel singled out this effect, calling it "dramatic," and said that it is in specific need of replication.

(continued on p.7)

Congress To Hold Hearings

The House Subcommittee on Water and Power Resources plans to hold hearings on the potential health risks associated with exposure to power line electromagnetic fields when Congress reconvenes in the fall. The subcommittee is chaired by George Miller, Democrat of California.

The hearings are prompted by the New York State report, a subcommittee aide told *Microwave News*. She added that Congressman Miller – who also chairs the Select Committee on Children, Youth and Families – is particularly concerned about the potential cancer threat to children.

The hearings were tentatively scheduled for mid-September. At press time, no decision had been reached on who will be invited to testify.

HIGHLIGHTS

The Talk of BEMS

The action started early at this year's Bioelectromagnetics Society (BEMS) conference.* In his introductory remarks at the opening session, Dr. Ross Adey digressed to lash out at Drs. Ken Foster and Bill Guy for their "flight of fancy" in ignoring all but thermal effects in their article on microwaves in *Scientific American* (see *MWN*, November/December 1986): "We have a responsibility, individually and collectively as a society, to communicate athermal effects to society and lawmakers," Adey said, noting the irony that the next four speakers would address the detection of weak electromagnetic fields for navigation and orientation.

Moments later, John Mitchell, Dr. Dave Erwin and Dr. Jonathan Kiel, all of the U.S. Air Force walked out of the ballroom, together with Foster, Dr. Eleanor Adair of the John B. Pierce Foundation and Dr. John Bergeron of GE. Foster refused to talk about his protest. Others were more forthcoming: "It went beyond the privilege of chairing a session," Erwin told *Microwave News*. For his part, Bergeron said he was "responding personally to something that was totally inappropriate."

Few in the audience were without an opinion. Many thought that Adey had chosen the wrong time to pick a fight, but Dr. Steve Baumann of Northrop Services, Inc., expressed a view shared by many when he said that he thought Adey's remarks were "particularly appropriate," because *Scientific American* is perceived as the arbiter of "what is valid in science."

*****

Henry Kues of the Johns Hopkins University Applied Physics Lab and Jack Monahan of the Food and Drug Administration presented startling new evidence of damage to the corneal endothelial layer of a monkey's eye caused by microwaves acting alone and in combination with drugs (see *MWN*, September/October 1986). The lesions on the surface of the cornea – a crater-marked landscape – are clearly visible in Kues and Monahan's photographs, leading them to suggest that this effect could be used as a diagnostic technique for acute overexposure to microwaves.

Kues and Monahan stressed that you have to look for the lesions. "I asked an ophthalmologist to examine some exposed and control eyes of live monkeys and, after a slit-lamp examination, he pronounced them normal," Kues said during a break at the meeting. "He was amazed when I showed him the lesions. He could not believe he had missed them."

Kues and Monahan found that pulsed microwaves can cause changes at an SAR of 2.6 W/Kg. But if the eye is first treated with drugs used in glaucoma therapy, the threshold is reduced to less than 1.3 W/Kg. Surprisingly, they have found the same action with two different drugs – timolol maleate and pilocarpine – that act in opposite ways to relieve the intraocular pressure associated with glaucoma. They were quick to point out that some two million Americans take these glaucoma drugs on a regular basis.

The mechanism of interaction is not yet clear, but Kues and Monahan have shown that the blood barrier in the eye leaks following radiation exposure. They speculated that transferrin, a catalyst for the formation of superoxides, may be passing through the barrier and causing the damage to the corneal endothelial layer.

The next step, Kues and Monahan said, is to look at the effects of microwaves on the blood barrier in the brain. They plan to begin those experiments soon.

*****

In the past, speakers from the floor were likely to ask whether temperature changes had been measured following radiation exposure or SARs had been calculated. This year, there were many more questions as to whether researchers had measured the local geomagnetic field.

Dr. Abe Liboff of Oakland University and Dr. Bruce McLeod of Montana State University, along with Dr. Carl Blackman of the Environmental Protection Agency, are largely responsible for this new trend. In Portland, Liboff and McLeod reviewed three sets of experimental data – on rats, diatoms and lymphocytes – which agreed with their *a priori* predictions based on their cyclotron resonance model.

Cyclotron resonances have come a long way as a predictor of bioelectromagnetic interactions, yet many of the early arguments against them still need answers. As Dr. Charles Polk of the University of Rhode Island explained, complications arise due to both collisions among particles and the "smearing out" of the resonances as the target moves in the magnetic field.

Skepticism still abounds. Nevertheless, few took issue with Liboff and McLeod when they said that the data "suggest very strongly that we are on the right path."

Dr. Carl Durney of the University of Utah also scored a success with his new model of the movement of a charged particle in combined DC and AC magnetic fields. The model is extremely simple, but it does, under the right conditions, predict both frequency and amplitude windows, similar to those found by Adey and Blackman in their work on calcium efflux.

*The *9th Annual Meeting of the Bioelectromagnetics Society* (BEMS) was held June 21-25 in Portland, OR.