

# MICRO WAVE NEWS

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## New Support for Cancer Risk from RF/MW Exposure

Preliminary results from an ongoing prospective epidemiological study support earlier findings of a link between cancer and exposure to radiofrequency and microwave (RF/MW) radiation, according to Dr. Stanislaw Szmigielski and coworkers at the Center for Radiobiology and Radioprotection in Warsaw, Poland. Szmigielski is directing a five-year project to assess the cancer risk among military personnel.

In a letter to *Microwave News*, Szmigielski reports that, "Preliminary results available after [a] 1.5-year period support our earlier findings from retrospective studies, indicating higher morbidity of all malignancies, especially of certain forms of leukemias and lymphatic neoplasms with relation to duration and intensity of RF/MW exposure." He cautions, however, that too little data are yet available to assess their statistical significance.

The new results are also consistent with the data on rats from the study at the University of Washington in Seattle indicating that RF/MW radiation may act as a cancer promoter (see *MWN*, July/August 1984 and March 1985).

The prospective study, started in 1985 and expected to run through 1989, will cover new cases of malignancies among Polish military career personnel. Szmigielski explains in his letter that the study will involve detailed analysis of past service history, including the duration and intensity of RF/MW exposures; he does not indicate the size of the study population. He is internationally known for his work on the effects of RF/MW radiation on the immune system. *(continued on p.13)*

### MWs as Co-Teratogens

In addition to his epidemiological studies, Dr. Stanislaw Szmigielski has also shown that microwaves can significantly enhance the teratogenicity of cytosine arabinoside (ara-C) in pregnant mice.

"The relatively weak embryotoxic effects of MWs may be significantly enhanced after combination with other teratogens," according to Szmigielski and colleagues from the Center for Radiobiology and Radioprotection and the National Institute of Mother and Child. They report their results in a paper in *Biology of the Neonate*, 50, pp. 75-82, 1986 (see also *MWN*, April 1984). Both the center and the institute are in Warsaw, Poland.

*(continued on p.5)*

# HIGHLIGHTS

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## Will EMPRESS II Close Down Baltimore Harbor?

The Navy's revised assessment of the effects of a powerful electromagnetic pulse (EMP) simulator on Chesapeake Bay has met with strong criticism. At a public hearing on January 29, Maryland state officials protested that the operation of the simulator would force the closing of the Port of Baltimore for as many as 20 days per year, severely damaging the local and state economies. The hearing was held to review the *Supplemental Draft Environmental Impact Statement (SDEIS)*, a bulky two-volume document issued by the Navy in December.

State officials also repeated their concerns that the simulator might interfere with the operation of a nuclear power plant located on the bay, as well as with ships' and recreational boats' navigational equipment (see box on opposite page), and that it might cause long-term biological harm to the bay's aquatic life. Maryland officials first grew concerned over the Navy project in September 1984, following the release of the first *Draft Environmental Impact Statement* for the proposed simulator (see *MWN*, October and November 1984).

The Second Electromagnetic Pulse Radiation Environment Simulator for Ships – EMPRESS II – would produce a maximum pulse of 7 megavolts (MV), allowing the Navy to test the susceptibility of shipboard electronic equipment to repeated EMPs similar to those produced by nuclear weapons. EMPRESS II would produce pulsed electric fields of 50 kV/m at 100 yards at 30-minute intervals.

The Navy wants to site EMPRESS II on a barge near Bloodsworth Island in Chesapeake Bay and is planning to limit access in a zone with a two-mile radius around the antenna. The new pulser would replace EMPRESS I, a smaller EMP simulator located at the Patuxent Naval Air Test Center on the shores of the bay.

### **Economic Impact**

In written comments submitted following the hearing, Dr. Torrey Brown, Secretary of Maryland's Department of Natural Resources, said that the Navy was wrong in concluding that operation of the simulator would have only a limited impact on shipping: Because the only deep-water channel in and out of the port passes through the proposed EMPRESS II restricted zone, large ships would be blocked when the simulator is in operation. Brown explained, "This has the potential for irreparable harm to the port if these ships cannot have ready access through the Chesapeake Bay." David Wagner, Baltimore Port Administrator, estimated that each ship's daily loss of access would cost \$14,700-\$21,000.

The Association of Maryland Pilots (AMP) also registered strong opposition to the Chesapeake Bay siting. In a February 2 letter to the Navy, Captain Michael Watson,

president of the AMP, wrote that, "The [Navy's] suggestion that large ocean-going vessels navigate 'around' an EMPRESS II test circle, that has a diameter of four nautical miles, indicates a complete lack of understanding of the factors involved in the actual minute-by-minute running of a typical modern, high-speed vessel calling on the Port of Baltimore today."

In its SDEIS, the Navy for the first time proposed an alternative site for the pulser – Guantanamo Bay, Cuba, where the Navy maintains a base. But the SDEIS cautions that this secondary site may not be technically feasible. In addition, the Navy concluded that basing EMPRESS II in Cuba would increase costs.

Under the Chesapeake Bay proposal, the Navy would also use EMPRESS II, which is expected to cost \$10-20 million, for tests at sea off the coast of North Carolina. This aspect of the plan has generated relatively little controversy.

According to the SDEIS, the Navy plans to spend up to 31 days setting up and testing EMPRESS II in fiscal year (FY) 1988, followed by a maximum of 60 days per year of actual EMP experiments – 20 days in Chesapeake Bay and 40 days at sea – beginning in FY89.

But Congressman Roy Dyson, who represents Maryland residents of the Chesapeake Bay area, has blocked the operation of EMPRESS II and plans to continue to do so. Last year, Dyson, a Democrat, succeeded in getting Congress to amend the Department of Defense Authorization Bill for fiscal year FY87 to prohibit EMPRESS II testing. A Dyson aide told *Microwave News* that the congressman plans to introduce the ban again for FY88.

### **Biological Effects**

Dr. Brown also charged that the Navy's investigation of possible biological effects of EMPRESS II was short-sighted. In his comments to the Navy, Brown argued that, "While there appears to be little evidence of acute impacts of EMP[s] on estuarine biota, the studies presented in the SDEIS fall far short of any conclusive demonstrations to support findings of no significant impact." He added that the Navy presented no data on chronic EMP effects or on EMPRESS II's potential to affect wildlife migratory patterns.

The Chesapeake Bay Foundation (CBF), an environmental/conservation organization based in Annapolis, MD, also expressed concern about biological effects. According to CBF's Stuart Lehman, research done for the SDEIS indicates possible effects that must be studied more closely before EMPRESS II starts operating.

For example, Dr. Shirley Pomponi of the University of Maryland's Horn Point Laboratories in Cambridge found

## EMPRESS II EMI to Nuclear Power Plant and Ship Electronics

Maryland state officials remain concerned that pulsed radiation from EMPRESS II may be strong enough to "induce 'upset' level electrical currents" at the Calvert Cliffs nuclear power plant, 20 miles from the test site, as well as to disrupt shipboard navigation equipment.

In a September 1985 report included in its *Supplemental Draft Environmental Impact Statement (SDEIS)*, the Navy projects fields of between 17 and 135 V/m at the plant, depending on the attenuation rate of the signal. The Navy concludes that these levels are "very unlikely" to interfere with electronic systems at Calvert Cliffs, but that, "It would be prudent, however, to conduct a careful monitoring program at the power plant during the initial tests of EMPRESS II."

But Dr. Victor Granatstein, a consultant for the state, maintains that the maximum field "would likely be as large as 155 V/m" – a factor of 31 times larger than that produced by EMPRESS I. "One cannot rule out in advance the possibility that order of magnitude increases in pulse power could produce qualitatively different effects at the power plant," Granatstein says.

Maryland officials are urging the Navy to develop a detailed monitoring system for Calvert Cliffs if it proceeds with its plan to site EMPRESS II on Chesapeake Bay.

Concerns about possible hazards at Calvert Cliffs due to EMI from EMPRESS II surfaced in 1984 when the Navy issued its first *Draft Environmental Impact Statement* (see *MWN*, October 1984).

Some experts have warned that an EMP from a nuclear bomb could cause false trips at a nuclear plant, potentially leading to a core meltdown in a worst-case scenario (see *MWN*, April 1983).

State officials, along with the Association of Maryland Pilots (AMP), also warn that EMP-generated EMI could wreak havoc with commercial and recreational

boats' navigational equipment. In a written statement, AMP President Captain Michael Watson told the Navy that "Merchant vessels, pleasure craft and commercial fishing boats...are *minimally protected* from EMP damage and will almost certainly suffer some degree of damage." A large ship subjected to an EMP could lose use of its gyrocompass, its magnetic compass, its Automated Radar Plotting Aid and even the computers that run its massive diesel engines, according to Watson. The potential consequences, he said, could be catastrophic.

Tests for the Naval Surface Weapons Center's White Oak Laboratory in Silver Spring, MD, on the susceptibility of navigational equipment to EMI – cited in the SDEIS – found that a LORAN transceiver did not suffer upsets at levels below 3.7 kV/m, but that a digital sailing instrumentation system was damaged at levels as low as 380 V/m.

In the SDEIS, the Navy concludes that "The two-nautical-mile radius exclusion zone is considered adequate for protection of [marine electronics] systems from damage." The Navy plans a similar protection zone for aviation electronics – air traffic would be prohibited below 6,000 feet. No interference with telephone equipment is anticipated by the Navy.

The state charges that the marine equipment tested did not represent the full range of navigational systems on ships that use the bay and calls for additional research.

Opponents of the Navy's plan to site EMPRESS II on Chesapeake Bay also question the Navy's conclusion that the risk of shocks to sailors is slight at the boundary of the two-mile radius safety zone. A potential shock hazard does exist, according to the state, creating a possible fuel-ignition problem for sailboats with masts taller than 20 meters and for large commercial vessels operating near the boundary of the exclusion zone.

"some differences" between control and exposed populations of oysters, crabs, bass and other marine species: "The results were inconsistent, however, and varied both among species as well as within the same species." Pomponi, who studied the effects of EMPRESS I, recommended long-term studies. Her report to the Navy, "EMPRESS I: The Effect of High Energy Electromagnetic Pulses on Aquatic Biota," appears as an appendix to the SDEIS.

### Other Concerns

Patricia Axelrod, who is researching unintended electromagnetic ignition of nuclear ordnance and other explosive materials – so-called "HERO" risks – objected to the Navy's exclusion of this potential hazard from the SDEIS. She warned of the "extraordinary risk of weapon

accidents" in surrounding bay communities.

Mark Robinowitz, an environmentalist, urged the Navy to abandon EMPRESS II, arguing that it falsely assumes that a nuclear attack is survivable. In the event the Navy proceeds with its plan to site the simulator on Chesapeake Bay, he recommended that the state hold a public referendum on the Bloodsworth Island siting before EMPRESS II is permitted to operate.

Local fishermen and watermen also testified against EMPRESS II.

The two-volume SDEIS includes 31 appendices covering EMI, biological effects and a description of the option for siting EMPRESS II at Guantanamo Bay, Cuba. Copies of the SDEIS are available from Captain B.L. Powers, Program Manager, Department of the Navy, Naval Sea Systems Command, Washington, DC 20362.

### 47 kV/m Field Near VDT Cited in Skin Rash Case; AT&T Settles

Radiation measurements have identified high electrostatic fields near a type of VDT that was at the center of a dispute over an operator's skin rash. A few days before the case was to be heard by a workers' compensation board, AT&T, the operator's employer, settled out of court. The terms of the agreement are confidential.

Dr. Bill Guy of the University of Washington in Seattle measured a static field of 47 kV/m at 5 cm from the surface of a TAB Model 132/15 VDT at an AT&T office in Washington, DC, in late 1985. The TAB terminal was manufactured by Sykes Datatronics.

The National Institute for Occupational Safety and Health (NIOSH) commissioned Guy's radiation survey after an AT&T employee, Miren Alcorta, complained that she developed dermatitis after working on a similar TAB VDT. Alcorta's claim was to be heard by a workers' compensation hearing officer on February 11.

According to the Communications Workers of America's (CWA) Dave LeGrande, AT&T's first offer was rejected. LeGrande told *Microwave News* that he did not know the amount of money Alcorta received, but that, in any case, the settlement stipulates confidentiality. Alcorta was a member of CWA when she worked at AT&T.

Alcorta was represented by Martha Walfoort of the Washington, DC, law firm of Kirschner, Weinberg & Dempsey; William Dale of McChesney, Pyne & Duncan also in Washington, DC, handled the case for AT&T.

Guy's 47 kV/m measurement is in the upper range of static fields associated with VDTs. A comprehensive survey of 147 different models by Sweden's National Institute of Radiation Protection found that static fields ranged from insignificant levels to 50 kV/m, with a median reading of approximately 10 kV/m. The maximum reading was 64 kV/m.

Although there is no firm evidence that the electrostatic fields associated with VDTs cause skin disorders, some researchers believe they are linked (see *MWN* November/December 1985).

Because of changes at AT&T, Guy measured the fields on a different VDT – at a different office – than the one alleged to have caused Alcorta's skin rash.

Guy measured the electrostatic and electromagnetic fields associated with three different models of VDTs – 21 AT&T Model 45s and one AT&T Model 6300 PC, in addition to two TAB units. The 6300 had a static field of approximately 40 kV/m at 1 cm. All the Model 45s had very low static fields, except for one unit which, like the TABs, had a static field of nearly 50 kV/m at 5 cm.

Guy acknowledged to *Microwave News* that the TAB static fields were high. Ron Peterson of AT&T Bell Labs, who accompanied Guy during the survey, told *Microwave News* that he agrees with Guy's assessment.

According to an expert on electrostatic fields, Dr.

Jonathan Charry of ERI, Inc., in New York City, large fields are not uncommon in low humidity environments. "Guy's readings don't surprise me if they were taken in a low humidity environment," he said in a telephone interview. The humidity at the AT&T office was not measured at the time of the Guy survey.

Alcorta's attorney, Walfoort, told *Microwave News* that a Sykes Datatronics technician who checked Alcorta's original VDT told her that the office was too dry and advised the installation of a humidifier.

AT&T's Peterson said that the Model 45s had very low readings because the units were shielded to comply with TEMPEST standards. TEMPEST shielding is required by the federal government for contractors using electronic equipment to process classified information. The shielding ensures that signals emitted by the equipment cannot be picked up and decoded by an outside party.

Guy's report, *Measurement and Analysis of Electromagnetic Field Emissions from 24 Video Display Terminals in American Telephone and Telegraph Office, Washington, DC*, was obtained by *Microwave News* from NIOSH under the Freedom of Information Act. The report will become part of a Health Hazard Evaluation (HHE), which was requested by CWA in 1985.

#### WHO Panel: 1-Meter VDT Rule

A World Health Organization (WHO) panel has endorsed the recommendations of two Canadian health officials that VDT operators not work within one meter of the rear or sides of nearby terminals unless the machines have been tested and found to emit only low levels of non-ionizing radiation. Though the panel concluded that VDT radiation emissions are unlikely to harm operators, it nonetheless recommended that "it is good practice to avoid unnecessary exposure to non-ionizing radiation from the adjacent VDTs."

This is the first time that a public health group of any kind has formally cautioned about inadvertent radiation from neighboring terminals.

The panel's other recommendations included ergonomic suggestions on display, screen and workstation design.

The report, "Health Aspects of Work With Visual Display Terminals," was written by Drs. Ian Marriott and Maria A. Stuchly of Health and Welfare Canada. It appeared in the September 1986 issue of *Journal of Occupational Medicine*, and is being distributed by the WHO Regional Office for Europe. It does not represent official WHO policy.

## NBS EMC Course Notes for \$8.50

As in past years, staffers from the Electromagnetic Fields Division of the National Bureau of Standards (NBS) will offer a course on electromagnetic compatibility/interference (EMC/EMI) metrology, June 8-11, at a cost of \$750. Now you can buy the course notes, written by NBS's Drs. Mark Ma and Moto Kanda, for only \$8.50.

In a telephone interview, Ma said that the EMC community tends to take a "fix-it" approach to EMI complaints. In this course, he said, "we seek to teach an in-depth understanding of the theory behind EMI problems. Once the theory is understood, the problem is more easily

corrected without creating another one." Ma emphasized that it is always preferable to address EMC/EMI at the design stage, rather than later on.

(A current example of what appears to be bad EMC planning is the Air Force's B-1 bomber, whose radar-jamming and radar monitoring systems are incompatible. According to the January 12 *Aviation Week*, the cost of fixing this and related problems will be nearly \$200 million.)

The course material places special emphasis on measurement techniques, including reviews of TEM cells, reverberating and anechoic chambers and open field test sites. Also covered are shielding materials, probe antennas, out-of-band interference and conducted EMI. All that is missing from the notes is the course's half-day lab demonstration and a tour of the NBS installation.

A copy of *Electromagnetic Compatibility and Interference Metrology*, Technical Note 1099, is available for \$8.50, prepaid, from the Government Printing Office, Washington, DC 20402. Order No. 003-003-02760-0. For a list of other recent NBS publications, see "New from NBS" in Measurement Update on p.11.

### ZAP!

Six hundred scientists and engineers with security clearances spent the first week of December at Kirtland Air Force Base in New Mexico examining the potential of high-power microwaves to zap enemy electronics. This was the 3rd National Conference on High-Power Microwave Technology for Defense Applications; at the second conference, in 1983, 300 people attended. (By comparison, in 1986, 238 people were at the Bioelectromagnetics Society meeting and nearly 2,000 attended the IEEE Electromagnetic Compatibility Society symposium.)

The proceedings of the meeting are classified, but it is known that more than 70 papers and 100 posters were presented. Many branches of the Department of Defense were represented, including the Air Force, the Army and the Navy, together with DARPA, DIA and DNA. The Lawrence Livermore, Los Alamos and Sandia National Labs were also well represented, as were most of the big defense contractors - General Dynamics, Physics International and TRW each have a high-power microwave testing facility.

In addition to sessions on sources, susceptibility and hardening, there was one on biological effects: Dr. David Erwin and Major Robert Downs represented the Air Force and Howard Bassen and Dr. John D'Andrea described the Army and Navy programs, respectively. Dr. Frank Barnes of the University of Colorado in Boulder presented a poster paper on his and Dr. Howard Wachtel's research on the effects of pulsed microwaves.

Chuck de Caro, a former correspondent for the Cable News Network, considers the possibility that the U.S. is falling behind the U.S.S.R. in microwave weapons in "The Zap Gap," to be published in the March issue of *The Atlantic* (see also *MWN*, November/December 1986.)

### MWs as Co-Teratogens (continued from p.1)

In the experiment, the mice were irradiated two hours daily on days 1-18 of gestation with 2450 MHz radiation at power densities of 1, 10 or 40 mW/cm<sup>2</sup>. The researchers injected some of the mice with ara-C on the ninth day of pregnancy. The synergistic effect increased along with exposure level and was statistically significant even at 1 mW/cm<sup>2</sup>.

The researchers also report that fetuses of mice exposed to "nonthermal" fields (1 and 10 mW/cm<sup>2</sup>) had significantly lower body masses than did sham-exposed fetuses, but there was no increase in malformations or resorptions.

The team recommends continued research on microwave teratogenicity, particularly that using other known environmental and/or occupational teratogens.

Previously, Szmigielski reported that 2450 MHz microwave radiation acts as a *co-carcinogen* with 3,4-benzopyrene: exposed mice suffered accelerated development of both spontaneous and chemically-induced skin cancer (see *MWN*, May 1981 and *Bioelectromagnetics*, 3, pp. 179-191, 1982).

The new findings were drawn from a report on the *Developmental and Teratogenic Effects of 2450 MHz Microwaves in Mice*, which was edited by Szmigielski and Dr. Bogdan Chazan of the National Institute of Mother and Child. The report summarizes results from a series of experiments conducted between 1982 and 1985 by the eight-member team at the Warsaw center; they were supported by the U.S. Center for Devices and Radiological Health.

To obtain a reprint of the paper or a copy of the full report, write to Szmigielski at the Center for Radiobiology and Radioprotection, 128 Szaserow, 00-909 Warsaw, Poland.

## **EPRI Steps Up ELF Bioeffects Research Program**

The Electric Power Research Institute (EPRI) has added \$1 million to its 1987 budget for studying the bioeffects of power line electromagnetic fields. The increase to \$2.7 million comes in response to "a heightened concern in the utility industry," according to Bob Black, manager of EPRI's non-ionizing radiation program. EPRI will soon fund two occupational health projects, including a major epidemiological study - as well as basic research on mechanisms.

"Industry is clamoring for us to do some good research," Black told *Microwave News* in a telephone interview from his office in Palo Alto, CA. "The issue is getting the attention of a number of members of the utilities' senior management." The call for more work on the risks associated with power lines follows the release of a number of studies linking extremely low frequency (ELF) fields to cancer, especially new support for the apparent link between ELF fields and childhood cancer (see *MWN*, November/December 1986).

Black said that one EPRI vice-president characterized the power line health debate as "a jugular issue for the industry."

One indication of the seriousness of the problem was the front page story in the December 3 issue of *The Energy Daily*, headlined "Transmission Link to Cancer Feared by EPRI." The article was based on an interview with Dr. Leonard Sagan, the head of EPRI's radiation program. In the article, he was quoted as saying: "If you had asked two years ago if electromagnetic fields were harmful, I would have said there was no evidence of harm or potential harm....But now, I have to say there are some issues that have arisen that have to be resolved before answering that question." Sagan went on to say that the issue must be studied: "Lawyers know about this stuff. Reporters will know about it soon enough. We don't have a choice."

Late last year, EPRI released a request for proposals (RFP No.799-27) for an "Assessment of Electromagnetic Field (EMF) Exposure by Occupational Job Title." The objective of this effort is to "(1) test the validity of occupational titles as meaningful surrogates of electric and magnetic field exposure measurements, and (2) identify populations for future study of the claimed association of cancer and field exposure." Black said that he has received six proposals for this effort and expects that the award will be announced in mid-March or early April.

In February, EPRI is releasing a second RFP asking for bids for a major epidemiological study of workers exposed to ELF fields. Black said that the study will take four to six years to complete. He anticipated that a full year of planning will be needed before the study can get underway. He added that EPRI will seek the cooperation of a utility to

facilitate the study.

EPRI has set up a panel of scientific experts to set research priorities for the institute's senior management. Dr. H.B. Graves, a consultant based in the Washington, DC, area, is the chairman of the panel. Graves was the chairman of two other committees that investigated ELF health risks: one for the American Institute of Biological Sciences (see *MWN*, May 1985) and one for the Florida Electric Power Coordinating Group (see *MWN*, July/August 1985).

At a panel meeting held in San Diego, CA, January 29-30, five groups were formed to evaluate research needs. The chairmen and their areas of specialization are: Dan Bracken, a consultant based in Portland, OR, on exposure assessment; Dr. John Peters of the University of Southern California in Los Angeles on epidemiology; Dr. Tom Tenforde of the Lawrence Berkeley Lab in California on biophysical mechanisms; Jack Lee of the Bonneville Power Administration on DC fields, and Dr. Marvin Goldman of the Energy-Related Health Research Lab at the University of California at Davis on animal carcinogenesis.

Black said that Graves is scheduled to coordinate the recommendations of the five groups and to submit a report to EPRI by the end of February. He added that some of the new \$1 million research fund will be used to pursue the panel's recommendations, but that only good proposals will be supported.

EPRI has also issued an RFP for basic research on mechanisms of interaction between ELF fields and biological systems. A notice announcing this RFP (No.799-26) appeared in the December 19 issue of *Science*. Those receiving awards, which will be patterned on those of the National Science Foundation, will be funded for up to three years. The deadline for applications is in early April.

### **Video on Mechanisms**

Dr. Ross Adey has produced a 15-minute animated video showing how cells can "communicate" through weak electrical signals.

The video, *Cell Membranes and Intercellular Communication*, is a graphic description of Adey's emerging theory on the way in which electromagnetic radiation may influence the promotion of cancer. It illustrates how signals can be amplified on the surface of the cell membrane and then transmitted inside it.

The art work is by Frank Armitage, best known for his work on *The Fantastic Voyage*, a 1966 medical/science fiction thriller. The video was made at the Walt Disney studios in Los Angeles, CA, and paid for by the Veterans Administration (VA). Adey is the Associate Chief of Staff for R&D at the VA Hospital in Loma Linda, CA.

The video will be publicly available later this year; we will publish ordering information as soon as it is released.

## **Swedish Academy of Engineering: ELF Fields May Not Be Risk Free...**

A committee of the Royal Swedish Academy of Engineering Sciences is no longer confident that power line fields are safe. In its just-released 1986 report, the committee states that a growing body of work indicates a potential hazard.

While stressing that more research is needed, the committee warns that the possible link between extremely low frequency (ELF) magnetic fields and cancer must be "taken far more seriously than before."

Reprinted below is the English translation of the summary statement of the academy's Committee for Biological Effects of Power Frequency Electric and Magnetic Fields:

The Royal Swedish Academy of Engineering Sciences (IVA) Committee for Biological Effects of Power-Frequency Electric and Magnetic Fields has compiled a 1986 report, evaluating the recent research in this area.

In the 1983 report (IVA-Rapport 240) it was stated that there is a range of well established effects of power-frequency electric and magnetic fields, but that none of these effects were judged to constitute a health hazard. Since then, international research in the area has been intense and a great number of investigations have been published. We find that the above judgment may still be valid even today. However, there are more studies than before showing effects, such as if they can be confirmed they must be judged as being hazardous to health. Primarily, it is the magnetic field which allegedly can cause these effects.

In the epidemiological studies concerning cancer and residential or occupational exposure to electromagnetic fields, there is some consistency in the different studies concerning an enhanced risk, particularly in certain forms of leukemia and for childhood tumors. However, results presented so far, are too vague for further conclusions to be drawn. The hypothesis about a relation between exposure to magnetic fields and cancer must however be taken far more seriously than before.

Further epidemiological as well as experimental research in this area is necessary for clarifying these important questions.

The committee's full report is only available in Swedish at this time.

## **...West Coast Transmission Projects Discount ELF Risks**

The draft environmental impact statement/environmental impact report (EIS/EIR) on two West Coast power lines dismisses the health risks associated with extremely low frequency (ELF) electric and magnetic fields.

The California-Oregon and Los Banos-Gates Transmission Projects plan to build two 500 kV power lines, approximately 340 and 84 miles long, respectively (see *MWN*, July/August 1985). The EIS/EIR concludes that, "There is abundant evidence that the electric and magnetic fields produced by the [California-Oregon] project are unlikely to pose a threat to the health and welfare of people, animals or crops. None of the major independent

scientific literature reviews has concluded that transmission lines of this type are unsafe."

With respect to the potential hazards associated with electric fields, the EIS/EIR finds that, "It appears that, in general, the presence of typical transmission line electric fields would not introduce any new or unique environments beyond the right-of-way edge that are not otherwise experienced in the normal household of working environments."

For magnetic fields, the EIS/EIR notes that, "In using a biophysical approach, biological effects from transmission line magnetic fields would not be expected."

For more information and/or to comment on the EIS/EIR, contact: Environmental Coordinator, California-Oregon Transmission Project, PO Box 660970, Sacramento, CA 95866, (916) 924-3995. The closing date for comments was recently extended until March 2.

## **ELF Bioeffects Roundup**

Outlined below are recent papers on the biological effects of extremely low frequency (ELF) fields.

P. Baroncelli, et al., "A Health Examination of Railway High Voltage Substation Workers Exposed to ELF Electromagnetic Fields," *American Journal of Industrial Medicine*, 10, pp. 45-55, 1986.

Medical exams and lab tests of 627 Italian railroad employees who work near interconnection and conversion substations operating at 220 kV show no evidence of health effects due to ELF exposure. Researchers based in Rome and Florence surveyed workers with mean maximum exposure levels to 50 Hz electric and magnetic fields of 5 kV and 15 uT, respectively, for 1, 10 or 20 hours per week. In addition to a general examination, the workers underwent tests of their cardiovascular, blood and nervous systems. The "results seem to indicate the absence of clear effects," the authors conclude. They note, however, that the limited number of parameters studied "does not allow us to give a definitive answer...." They suggest that their results could be used to determine the lower limits for an occupational ELF exposure standard.

J. Behari, et al., "Biological Effects on Rats of Chronic Exposure to 50 Hz Fields of Moderate Intensity," *Journal of Bioelectricity*, 5, pp. 335-342, 1986.

Researchers based in New Delhi, India, examined the biological effects of exposures to 50 Hz fields by measuring food and water intake, electrocardiograms (ECGs) and mortality rates in developing male rats. The exposed group ate and drank less and had higher amplitudes of R and T waves in their ECGs. The authors conclude that, though the effects are within physiological limits, 50 Hz fields create mild stress in rats.

Carl Blackman, et al., "Effect of Power Line Frequency Electric Fields on a Developing Organism," presented at the 8th Annual Meeting of the Bioelectromagnetics Society (BEMS), Madison, WI, June 1986.

Blackman presented experimental evidence that a 10 V/m electric field – commonly found in the home – is biologically active. Blackman and his colleagues at the Environmental Protection Agency (EPA) in Research Triangle Park, NC, exposed chick eggs to 50 Hz or 60 Hz electric fields at an average intensity of 10 V/m (rms) for 21 days. After hatching, the chicks were exposed to either 50 Hz or 60 Hz fields, and their brain tissues were examined for calcium efflux. Only those chicks exposed to 60 Hz *in ovo* followed by 50 Hz *post ovo* showed a response. In an interview at the conference, Blackman said that, while the significance of the finding is still unclear, it does indicate that exposure history can affect biological response. See also Blackman's paper on the influence of the local geomagnetic field, "A Role for the Magnetic Field in the Radiation-Induced Efflux of Calcium Ions from Brain Tissue *in Vitro*," *Bioelectromagnetics*, 6, pp. 327-337, 1985, and *MWN*, September 1984.

IIT Research Institute (IITRI), *Compilation of 1985 Annual Reports of the Navy ELF Communications System Ecological Monitoring Program*, Technical Report No.E06549-26, 3 Volumes, 1,352 pp. Prepared for the Space and Naval Warfare Systems Command, July 1986. Available from the National Technical Information Service, Springfield, VA 22161.

These ten progress reports describe the ongoing studies on the effects of electromagnetic fields generated by the Navy's ELF Communications System on the surrounding plant and animal life in Wisconsin and Michigan. In all, they examine the possible effects on 16 different organisms, including plants, fish, small mammals, birds, microorganisms and insects in streams, wetlands and forest ecosystems. To date, the research has primarily documented existing conditions at test and control areas and will serve as baseline data for later results. See also J. E. Zapotosky, *Extremely Low Frequency (ELF) Communications System Ecological Monitoring Program: Summary of 1985 Progress*, Report No.E06549-27, IIT Research Institute, Chicago, IL, October 1986.

J. Leal, et al., "Magnetic Environment and Embryonic Development: A Role of the Earth's Field," *IRCS Medical Science*, 14, pp. 1145-1146, 1986.

This short paper, the most recent one from Leal's group in Madrid, Spain, explores the influence of the Earth's magnetic field on the biological activity of very weak ELF pulsed magnetic fields on chick embryos: A "strong correlation" was found between the Earth's field and the number of abnormal embryos resulting from exposure to artificial pulsed fields. In addition, Leal and coauthors note that "the Earth's [magnetic field] may influence *per se* the development of the embryos, even in the absence of artificial fields." (Note that *IRCS Medical Science's* name was changed to *Medical Science Research* at the beginning of 1987; the journal is published by Elsevier.)

M.T. Marron, et al., "Effects of Sinusoidal 60 Hz Electric and Magnetic Fields on ATP and Oxygen Levels in the Slime Mold, *Physarum polycephalum*," *Bioelectromagnetics*, 7, pp. 307-314, 1986.

Cultured slime mold cells, continuously exposed for 120-180 days to 60 Hz 1 V/m and 1.0 G electric and magnetic fields,

respectively, singly and in combination, had significantly reduced levels of adenosine triphosphate (ATP), an essential element in cell metabolism. The research group, based at the University of Wisconsin-Parkside in Kenosha (Marron is now at the Office of Naval Research in Arlington, VA), also observed a significant drop in the respiration rate of cells exposed to the combined fields and to the electric field alone but not those exposed to the magnetic field alone. The authors suggest that the significant decreases induced by the electric and by the combined fields indicate that "more than one mechanism of interaction may be involved in inducing an [electromagnetic field] effect." This is a continuation of research that has been ongoing for 10 years. The team is part of the Navy's Project ELF program. Earlier findings demonstrated that exposure of these organisms to electromagnetic fields lengthened their mitotic cycles and lowered their respiration rates.

Y.J. Seto, et al., "Chronic 60 Hz Electric Field Exposure-Induced Subtle Bioeffects on Hematology," *Environmental Research*, 39, pp. 143-152, 1986.

In this, their most recent paper, researchers at Tulane University in New Orleans, LA, report that rats exposed to 80 kV/m, 60 Hz electric fields for 120 days had significantly lower total white blood cell counts, as well as depressed lymphocytes and eosinophil counts. The exposure did not affect red blood cells, however. The team concludes that "animals chronically exposed from the time of conception...show a response similar to that observed with chronic exposure to some other mild stressors." The authors emphasize, however, that the effects are "small in absolute magnitude." For a synopsis of the team's earlier papers, see *MWN*, January/February 1985.

Richard G. Stevens, "Electric Power Use and Breast Cancer: A Hypothesis," *American Journal of Epidemiology*, April 1987 (in press).

According to Stevens, ELF fields may be responsible for the increased breast cancer rates in industrial countries. Experiments have shown that (1) both constant light and 60 Hz fields suppress melatonin production by the pineal gland – as little as 0.022 uW/cm<sup>2</sup> light can have this effect; (2) melatonin can inhibit chemical-induced breast cancer, and the removal of the pineal gland enhances carcinogenesis; and (3) rats exposed to constant light have a greater incidence of chemical-induced breast cancer. In this paper, Stevens proposes to test the hypothesis that ELF fields can also promote breast cancer in rats, taking care to control for the possible confounding action of light.

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## BIOLOGICAL EFFECTS

**Light and Rhythms...**Bright light in the morning can alleviate Seasonal Affective Disorder (S.A.D.), the depression and fatigue associated with winter's short days, but applying the same therapy in the evening does not help, according to a new study by Dr. Alfred Lewy and coworkers at the Oregon Health Sciences University in Portland. Though researchers have known that bright light – but not indoor light – suppresses melatonin, a hormone secreted at night, the way light relieves S.A.D. has been unclear. Now, in a paper in *Science* (January 16, 1987), based on a study of eight S.A.D. patients, the Oregon team puts forward the explanation that the antidepressant effect "is at least in part related to advancing the phase of the melatonin onset and, by implication, other circadian rhythms as well."...Lewy's results are consistent with the work of Dr. Charles Czeisler and colleagues, also published in *Science* (August 8, 1986), which shows that bright light in the evenings sets back the cycle: they conclude that evening light could provide relief for those who experience shift work insomnia or jet lag....*The Lancet* (August 30, 1986), England's leading medical journal, cautions against actually taking melatonin for jet lag. An editorial suggests that the hormone may just disturb, not actually shift, the circadian rhythm....The influence of the circadian cycle on the efficacy of drugs is addressed in a news item in the *New Scientist* (January 16, 1986). It cites a study in which the toxic side effects of cancer chemotherapy depended on the time of day the drugs were administered....For background, see Drs. Carl Hirschie Johnson and J. Woodland Hastings's "The Elusive Mechanism of the Circadian Clock," *American Scientist*, January/February 1986 and *MWN*, September/October 1985....Also see the letter on melatonin cycles among night shift workers by Dr. Franz Waldhauser and colleagues at the University of Vienna, Austria, in the *New England Journal of Medicine* (December 18, 1986).

**No Effect with MM Waves...**Do millimeter (MM) waves have a non-thermal effect on the growth rates of microorganisms? Experiments designed to answer this question continue to yield conflicting results. The debate started in the late 1960s and early 1970s when both Canadian and Soviet researchers published papers showing that GHz radiation is biologically active. A number of German scientists looked into the problem and, in a series of elegant studies, showed that yeast had an extreme sensitivity to specific frequencies in the 41 GHz radiation band: they found that growth was enhanced and inhibited at frequencies only 8 MHz apart. On the other hand, groups at the Polytechnic University in New York City and at the University of Utah in Salt Lake City were unable to show any activity (see *MWN*, October 1983). The Utah team – Drs. Luciano Furia, Douglas Hill and Om Gandhi – has recently published the results of their attempts with yeast cultures, exposed to 15 different frequencies in three bands

between 41.650 and 41.798 GHz; in each case, they found no change in growth rates. Writing in the November 1986 issue of the *IEEE Transactions on Biomedical Engineering*, the Utah group advocates "extreme caution" when interpreting papers – especially those by S.J. Webb – that use the positive results with MM waves as the basis for new applications for cancer diagnosis and therapy. In a telephone interview, Gandhi said that the experiments with MM waves are continuing.

**Electrostatic Effects...**Male rats exposed to electrostatic fields had offspring with congenital abnormalities, according to a new report from Indonesia (*International Journal of Andrology*, 9, pp. 152-160, 1986). This is the first study to link electrostatic fields with birth defects. Drs. Oentoeng Soeradi and M.K. Tadjudin of the Department of Biological Sciences at the University of Indonesia School of Medicine in Jakarta exposed the testes of male rats to electrostatic fields of 1 to 7 kilovolts (kV) and found that fertility was diminished. At exposure levels of 6 to 7 kV, offspring suffered from a host of defects.

**A New Look for Health Physics...**In its 29th year of publication, *Health Physics*, the journal of the Health Physics Society, has been changed to a new 8-1/2-by-11 format. According to Editor Genevieve Roessler, a principal motivation for the new design was to make it easier for advertisers who are geared to this larger page size. Representing the non-ionizing radiation community in the first issue of Volume 52 (January 1987) are Drs. Don McRee and H.G. Davis of NIEHS in Research Triangle Park, NC, with a paper on the "Effects on Energy Absorption of Orientation and Size of Animals Exposed to 2.45 GHz Microwave Radiation."

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## COMMUNICATIONS

**Healy Heights Survey...**As we go to press, the FCC has released the results of last summer's EPA-FCC measurement survey of RF/MW radiation levels near the Healy Heights antenna farm in Portland, OR (see *MWN*, September/October 1986). Some of the readings inside houses approached 200  $\mu\text{W}/\text{cm}^2$ , although "typical levels" were below 100  $\mu\text{W}/\text{cm}^2$ . We will feature more details of the survey in our next issue. For a copy of the report, contact: Dr. Robert Cleveland, Office of Engineering and Technology, FCC, 2025 M Street, NW, Washington, DC 20554, (202) 653-8169; or Richard Tell, Office of Radiation Programs, EPA, PO Box 18416, Las Vegas, NV 89114, (702) 798-2440.

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## COMPATIBILITY & INTERFERENCE

**Woodpecker Project...**A preliminary report on the interference caused by the Soviet Union's over-the-horizon

## UPDATES

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(OTH) radar has been completed and will be distributed at the 1987 World Administrative Radio Conference (WARC) for High Frequency (HF) Broadcasting, which began in early February in Geneva, Switzerland. The Association of North American Radio Clubs' Woodpecker Project – so named because the OTH produces a pecking sound on communications receivers – coordinated 96 shortwave listeners in 18 countries, who monitored the OTH signal during October 1985 (see *MWN*, July/August 1985). The report includes an analysis of the radar's transmission patterns, as well as the effects on 35 broadcasting stations. It concludes by recommending that the WARC delegates adopt a resolution condemning Woodpecker-type interference with the HF band. The 63-page report, prepared by Robert Horvitz, is available for \$7.00 in the U.S. and Canada and \$9.50 elsewhere (via air mail), prepaid, from the Woodpecker Project, 1634 15th Street, NW, Washington, DC 20009.

**Amador Wins Japanese Accreditation...**Amador Corp., an EMC testing company based in Taylors Falls, MN, is the first company *outside* Japan to win approval as a certified measurement facility for testing under the new standards promulgated by the Japanese Voluntary Control Council for Interference (VCCI). According to Amador's Cynthia Weber, VCCI certification will enable U.S. electronic equipment manufacturers to compete more effectively with their Japanese counterparts. For more information, contact Weber at Amador, Wild Mountain Rd., Almelund, MN 55002, (612) 583-3322....On March 1, Amador will open a new testing lab in St. Paul, MN, which was purchased from Medtronic, Inc., best know for its line of cardiac pacemakers. Under the terms of the purchase, Amador will do EMC testing for Medtronic.

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### EMP

**FCC Petition Denied and Appealed...**Nickolaus Leggett and Donald Schellhardt are persisting in their efforts to get the FCC to study the possible protection of civilian communications systems from EMP radiation. On December 5, Albert Halprin, chief of the FCC's Common Carrier Bureau, denied Leggett and Schellhardt's petition to open a formal inquiry (see *MWN*, September/October 1986). Halprin granted that the issues raised by the petition are "topical and important," but nevertheless decided that "they do not warrant examination by the commission at this time." He argued that because other DOD studies are ongoing, FCC action would be "premature." On January 5, Leggett and Schellhardt asked the commission to reconsider, contending that the FCC "has underestimated the availability of information on EMP, underestimated the seriousness of the EMP problem and overestimated the effectiveness of ongoing private sector responses." At this point DOD stepped into the fray, urging the FCC to stand

firm because DOD is acting to protect civilian telecommunications – 95% of DOD's communications are on commercial systems – and because most of the technical details are classified. (The Defense Nuclear Agency and the Defense Communications Agency are already developing an EMP protection standard, DOD noted.) Leggett and Schellhardt answered back that the whole process should be opened up to public scrutiny. This time the petition will be reviewed by the FCC commissioners themselves.

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### INTERNATIONAL

**WHO Directory...**The World Health Organization's (WHO) Regional Office for Europe has issued *Institutions and Legislation Concerned with Non-Ionizing Radiation Health-Related Research and Protection: A Directory – 1986*. It was compiled and edited by Dr. Michael Suess, of the WHO regional office in Copenhagen, Denmark, and Deirdre Benwell, the head of the non-ionizing radiation section at the Canadian Radiation Protection Bureau in Ottawa. The 66-page directory, which covers UV, visible, IR, MW, RF and ultrasound, consists of two tables: the first lists every country's laws and institutions which address these types of radiation; the second lists the names and addresses of individuals working on these issues. Much of the information in the tables was collected in the late 1970s and updated in 1985. Periodic updates are planned, according to Benwell. A limited number of copies of the directory are available. In North America, contact Benwell at the Radiation Protection Bureau, Environmental Health Center, Room 233, Tunney's Pasture, Ottawa, Ontario K1A 0L2, Canada. In Europe, contact Suess at the WHO Regional Office for Europe, Copenhagen, Denmark.

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### LITIGATION

**The Next Asbestos?...**Will personal injury suits over the adverse health effects of microwave radiation grow in the same way that litigation over asbestos has? Dr. Allan Frey of Randomline, Inc., argues that this scenario is very likely in the cover story of the January 1987 issue of *The Pennsylvania Lawyer*. He warns that unless more bioeffects research is funded and unless adequate controls are placed on emissions, the microwave industry may be crippled by an angry public unwilling to accept any future sources of radiation.

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### MEASUREMENT

**Monitoring RF Heat Sealers...**Narda Microwave Corp. is now marketing a new meter to measure electromagnetic fields in the 10-40 MHz frequency band. The Model 8512 is designed to monitor emissions from RF heaters and sealers, many of which operate at 27 MHz. The

battery-powered meter and probe cost \$995.00, less than the more sophisticated units that can measure over a larger frequency range. It may be used with two different scales – up to 5 mW/cm<sup>2</sup> or 50 mW/cm<sup>2</sup> – and will overload at 50 W/cm<sup>2</sup>. According to Robert Johnson, Narda's instrument sales manager, the meter may be used by those who have not had specialized training. For more information, contact Johnson at 435 Moreland Rd., Hauppauge, NY 11788, (516) 231-1700.

**New From NBS...**Dr. Moto Kanda and Lanny Driver, of NBS's Electromagnetic Fields Division, have developed a new broad-band electric field probe, which can measure fields between 1 and 1,600 V/m from 1 MHz to 15 GHz, with a flat response to within  $\pm 2$  dB. The probe is only one cm in diameter and four cm long. For details, see their paper in the February 1987 issue of the *IEEE Transactions on Microwave Theory and Techniques*....Richard FitzGerrell describes "Standard Linear Antennas, 30 to 1000 MHz," in the December 1986 issue of the *IEEE Transactions on Antennas and Propagation* (see also below)....From the NBS's Technical Note (TN) series: • *Automated Measurement of Frequency Response of Frequency-Modulated Generators Using the Bessel Null Method*, J. R. Major, E.M. Livingston and R. T. Adair (TN 1093). Order No. 003-003-02728-6, \$1.75, prepaid, from U.S. Government Printing Office (GPO), Washington, DC 20402. • *Design, Evaluation and Use of a Reverberation Chamber for Performing Electromagnetic Susceptibility/Vulnerability Measurements*, M.L. Crawford and G.H. Koepke (TN 1092). Order No. 003-003-02734-1, \$7.00, prepaid from GPO. • *Linear Gain – Standard Antennas Below 1000 MHz*, R. G. FitzGerrell (TN 1098). Order No. 003-003-02736-7, \$2.25, prepaid, from GPO. • *NBS 50 kHz Phase Angle Calibration Standard*, R.S. Turgel (TN 1220). Order No. 003-003-02726-0, \$4.00, prepaid, from GPO. • *A Statistical Characterization of Electroexplosive Devices Relevant to Electromagnetic Compatibility Assessment*, Dennis S. Friday and John W. Adams (TN 1094). Order No. 003-003-02744-8, \$2.75, prepaid, from GPO. • *A Study of Techniques for Measuring the Electromagnetic Shielding Effectiveness of Materials*, Perry F. Wilson and Mark T. Ma (TN 1095). Order No. 003-003-02735-9, \$3.50, prepaid, from GPO.

### MEDICAL APPLICATIONS

**Characterizing Magnetic Fields...**FDA's Center for Devices and Radiological Health (CDRH) has developed a computer-based system to characterize and compare the pulsed magnetic fields associated with non-invasive bone healing devices. According to Dr. Whit Athey, chief of the electrophysics branch at the center's Office of Science and Technology, the system can analyze the amplitudes, waveforms and component frequencies of the pulsed fields.

"More attention needs to be placed on dosimetry and this system will help us do that," Athey told *Microwave News* in a telephone interview. He said that center scientists will soon begin looking at the output from transcutaneous electrical nerve stimulators, better known as TENS units. For more information, contact Athey, CDRH, HFZ-133, FDA, Rockville, MD 20857, (301) 443-3840.

### MEETINGS

**EMF Mechanisms at ACS...**Professor Martin Blank of Columbia University's College of Physicians and Surgeons in New York City is organizing a *Bioelectrochemistry Symposium on Surface Chemistry in Biology, Medicine and Dentistry* as part of the *American Chemical Society's (ACS) Spring Meeting*, to be held at the Marriott Hotel in Denver, CO, April 8-9. The symposium will review the influence of electric and electromagnetic fields on biopolymers, membranes and whole cells. In addition to Blank, the speakers will include: Drs. W.R. Adey, F.S. Barnes, J.O'M. Bockris, J.D. Bond, E. Findl, R. Goodman, I.R. Miller, T.Y. Tsong, H. Wachtel and J.C. Weaver. Blank organized a similar symposium in 1978 – the proceedings were published by ACS in 1980 as part of its "Advances in Chemistry Series" (No.188), *Bioelectrochemistry: Ions, Surfaces, Membranes*. Many of the scheduled speakers are also contributing to a forthcoming volume, *Mechanistic Approaches to the Interaction of Electric and Electromagnetic Fields with Living Systems*, edited by Blank and Findl, to be published by Plenum in late 1987 or early 1988.

**Magnetic Fields Proceedings...**In May 1985, Professor Jurgen Bernhardt hosted a *Symposium on the Status of Research on the Biological Effects of Static and Extremely Low Frequency Magnetic Fields*, sponsored by WHO, IRPA and the German Federal Health Office (see *MWN*, May 1985). He has now edited these papers and the proceedings have been published. For more information, contact Bernhardt, Institute for Radiation Hygiene, Federal Health Office, Ingolstadter Landstrasse 1, D-8042 Neuherberg, F.R.G.

**Power Line Bioeffects Review...**In past years, EPRI and DOE have held annual meetings for their contractors to present progress reports on their work. This year's meeting will be open to *all* researchers investigating power line bioeffects. April 1 is the deadline for notification of intent to present papers or posters; abstracts are due September 1. *Review of Research on the Biological Effects of 50/60 Hz Electric and Magnetic Fields, Air Ions and Ion Currents* will be held at the Hyatt Regency Hotel in Kansas City, MO, November 2-5. No travel funds are available. For more information, contact W/L Associates, Suite #4, 120 West Church St., Frederick, MD 21701, (301) 663-1915.

## UPDATES

**NIRO 1987...**The 1st Symposium on Biological Effects, Hazards and Protection from Non-Ionizing Radiation in Outdoor Applications (NIRO 1987) will be held in Stockholm, Sweden, August 12-16. The conference will primarily address lasers but will also consider microwave radiation. A number of invited speakers have already been lined up, including, on microwaves, Drs. Frank Barnes of the U.S., Kjell Hansson-Mild of Sweden, and Bernard Servantie of France. A Soviet scientist is scheduled to address non-thermal microwave effects on the central nervous system. Papers are being invited; abstracts are due by March 31. For information about submitting an abstract, contact Mrs. Margit Andersson, Dept. of Ophthalmology, Karolinska Hospital, S-104 01 Stockholm 60, Sweden, (8) 331710; for registration materials, contact the Kreab Congrex, Box 5619, S-114 86 Stockholm, Sweden, (8) 7234230.

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### OVENS

**Popcorn and Baby Bottle Burns...**Opening a bag of microwave popcorn may be hazardous to your health, according to a letter in the *New England Journal of Medicine* (November 20, 1986). Patricia Routhier and Dr. Arnold Matlin, of Geneseo, NY, and Dr. Reginald Ishman of Warsaw, NY, described the case of a 10-year-old boy who severely burned his eyelids while opening a bag of microwaved popcorn at face level. The rush of released steam caused first- and second-degree burns. The package carried a warning, "Handle the bag carefully -- It's hot!" "Obviously, this warning is not sufficient to prevent eye injuries," the authors wrote. This was not the first time a child has been injured by microwave-heated food: Two years ago, pediatricians reported that a baby suffered throat injuries after drinking formula heated in a microwave oven (W.C. Sando et al., *Journal of Pediatrics*, 105, pp. 864-867, 1984). The baby's burns were due in part to the fact that when formula is heated in a microwave oven, the liquid can be scalding hot when the bottle is only warm. The doctors warned that, "The safety of microwave ovens is operator dependent. Heating a bottle of infant formula in the microwave oven is popular and should be simple, but it is potentially treacherous when undertaken by the uninformed." They ended their case report with age-old advice for the microwave generation: pretest the formula before feeding the baby. Last spring, a researcher from the Shriner's Burns Institute in Cincinnati, OH, warned of a rise in burns from microwave ovens (see *MWN*, July/August 1986).

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### PEOPLE

**Bill Kaune**, long known for his work on the measurement and dosimetry of ELF fields at the Battelle Pacific Northwest Labs in Richland, WA, will join the National Bureau of Standards (NBS) in Boulder, CO, in March. At NBS, Kaune will be working with the microwave and millimeter wave noise measurements group.

**Walter Stoessel, Jr.**, the U.S. Ambassador to the Soviet Union from 1974 to 1976, died of leukemia on December 11. Stoessel was in Moscow when the news broke that the Soviets were beaming microwaves at the U.S. embassy – the irradiation had in fact started 23 years earlier. A State Department spokesman told UPI that Stoessel's and two other post-war ambassadors' cancer deaths had nothing to do with health hazards at the embassy. But syndicated columnists Rowland Evans and Robert Novak reported on December 13 that many U.S. government officials blame microwaves for Stoessel's death.

**Frank Harlen** of the U.K.'s National Radiological Protection Board (NRPB) collapsed and died at work on January 16. Harlen was one of the board's experts on radiofrequency, microwave and laser radiation; he was responsible for preparing many of its reports on non-ionizing radiation. He served in a number of working groups set up by the World Health Organization's Regional Office for Europe in Copenhagen and was a member of the IEC's committee on lasers.

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### POWER LINES

**International Concerns...**The Collingwood Community Health Center (CCHC), a citizens group opposing the construction of a 220 kV power line in Victoria, Australia, has published *Electromagnetic Fields, Electric Power and Public Health: A Community Resource Document Based on the Victorian Experience, 1985-1986* (see *MWN* July/August and September/October 1986). Prepared by Ian Macmillan, the 240-page report was designed to "make the technical aspects of the power line health effects debate more accessible and understandable to the public." Macmillan reviews the latest research and argues that the state utility, the government and their consultant, Dr. H.B. Graves, did not "properly consider a large number of the relevant studies" in approving the line. The report costs \$12.00 (Australian) for individuals and community/voluntary organizations and \$25.00 for others (add \$3.00 for postage) and is available from EMR Project Fund, CCHC, 154 Sackville St., Collingwood, Victoria 3066, Australia, (03) 419-6155....A similar dispute is brewing in the Republic of Ireland, where the Electricity Supply Board is expanding its 400 kV lines to send electricity generated at a coal-fired west coast power plant, eastward to Dublin.

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### STANDARDS

**Draft EMC Limits...**American National Standards Committee C63 has issued a draft of its proposed revision of ANSI C63.12-1984, *Recommendations for Electromagnetic Compatibility Limits (BSR C63.12)*. The standard does not specify suggested limits, but presents a rationale for developing them; it does not address limits for ISM equipment. A copy of the BSR C63.12 draft is available for \$7.00, prepaid, from Fred Huber, Jr., IEEE, 345 East 47th St., New York, NY 10017.

Szmigielski's project is the first prospective epidemiological study ever attempted. This effort, together with his earlier retrospective study of the Polish military, represents an unprecedented body of data on the possible carcinogenic effects of RF/MW exposures.

In 1985, Szmigielski and his colleagues released the results of their retrospective study, which found a significant increase in cancer among Polish military personnel exposed to RF/MW radiation. The data revealed that exposed personnel were three times as likely as those not exposed to develop cancer – tumors of the blood-forming organs and lymphatic tissue were nearly seven times more common than among unexposed servicemen. In addition, the study showed a strong correlation with exposure time. The paper appeared in Polish and was not widely distributed (see *MWN*, March 1985).

The first English summary of the 1985 findings, written by Szmigielski himself, will be included in a chapter in *Foundations of Modern Bioelectricity*, which will be published this summer by Marcel Dekker in New York City. The volume is edited by Dr. Andrew Marino of the Louisiana State University Medical Center in Shreveport.

In his chapter, Szmigielski presents an extensive summary of the results of the retrospective epidemiological study (see box below). "Immunological and Cancer-Related Aspects of Exposure to Low-Level Microwave and Radio-frequency Fields" is the most complete review ever prepared on the suspected link between cancer and exposure to RF/MW radiation. Szmigielski's coauthors are Marian Bielec, Slawonir Lipski and Grazyna Sokolska, all in the Department of Biological Effects of Non-Ionizing Radiation at the Warsaw center.

The chapter, drawing on close to 30 published papers on RF/MW exposure and cancer, concludes that animal studies have provided only "scanty evidence that exposure to low-level RF/MW radiation may in certain cases influence the complicated process of carcinogenesis, with tumor-promoting (direct or indirect) activity possibly being a general phenomenon." According to their review of the University of Washington rat study, those results "may be considered only as a trend for increased risk of cancer after prolonged MW exposures. The phenomenon needs further confirmation."

Szmigielski and his coworkers conclude that investigations of the cancer incidence among exposed human populations – including their own – "point to an urgent need for further epidemiological studies."

The chapter also covers research on immunological effects of RF/MW exposure. In general, the Polish team finds that there are insufficient data, but that available research suggests the existence of a "biphasic" reaction of the immune system to RF/MW radiation, starting with stimulation of the whole system after initial exposures, "followed by gradual, but transient, suppression of the whole immunity" with increasing exposure periods and/or power densities.

The University of Washington laboratory study that found an increased cancer risk among exposed rats also showed immunological irregularities.

For information on the availability and cost of *Foundations of Modern Bioelectricity*, contact Marcel Dekker, 270 Madison Ave., New York, NY 10016, or Dr. Andrew Marino, Dept. of Orthopedics, Louisiana State University Medical Center, PO Box 33932, Shreveport, LA 71130.

### **Summary of Polish Epi Study of Cancer Among Military Personnel**

In summary, from a retrospective study that covered a large and well-controlled population with a known population of subjects, and that had a relatively long period of observation (1971-1980) the following conclusions may be drawn:

- The risk of developing clinically detectable neoplastic disease was about 3 times higher for personnel exposed occupationally to RF/MW radiations. The highest risk appeared for malignancies originating from the hemato-lymphatic systems (morbidity about 7 times higher). Other more frequent neoplasms were located in the alimentary tract and in skin (including melanomas).
- The highest risk factor of cancer morbidity related to occupational exposure to RF/MW appeared for subjects at the age of 40-49 who had a 5-15 year period of exposure.
- Morbidity rates of neoplasms in personnel exposed occupationally to RF/MW showed strong correlation with the period of exposure.
- Neoplasms of the same localization and/or type developed earlier (by about 10 years) in personnel exposed occupationally to RF/MW than in those not working in the RF/MW environment.

The above findings are intriguing and disturbing for epidemiologists, medical officers, as well as for society as a

whole. It must be emphasized that results of retrospective epidemiologic studies are valid only for the population analyzed and the period of observation covered. Further, despite the correlations found and values of correlation coefficients, they do not provide certain evidence of a causative relationship between the effect and the factor investigated. In our population, we assume that exposure of subjects to other harmful and possibly carcinogenic factors, including smoking and drinking habits, in both the exposed and non-exposed groups were similar and we have no evidence to think differently.

At present we cannot offer a convincing explanation for the observed facts of increased risk of cancer in subjects exposed occupationally to RF/MW, and do not relate this finding directly to interactions of the radiation with the human organism at any level, until the recently started prospective studies of the same population, planned for 1985-1990, is completed. Nevertheless, the available results point to an urgent need for further epidemiological studies, both retrospective and prospective, in well-controlled populations of people exposed occupationally and/or incidentally to a variety of non-ionizing radiation, as well as for elucidation of cancer-related problems in experimental investigations.

# CONFERENCES

## 1987 Conference Calendar (Part II)

### Additions to Part I

March 21: 6th Annual Benjamin Franklin Symposium: Advances in Antenna and Microwave Technology, Hyatt Cherry Hill, Cherry Hill, NJ. Contact: Laura Jacobs, IEEE Office, Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia, PA 19104, (215) 898-8106.

April 8-9: Bioelectrochemistry Symposium on Surface Chemistry in Biology, Medicine and Dentistry, Marriott Hotel, Denver, CO. Held as part of the *American Chemical Society's Spring Meeting*. Contact: Professor Martin Blank, College of Physicians and Surgeons, Columbia University, 630 West 168th St., New York, NY 10032, (212) 305-3644.

April 22-24: 3rd Annual Meeting of the Electromagnetic Energy Policy Alliance (EEPA): Preemptive RF Standards - Chaos v. Order, Westin Hotel, Washington, DC. Contact: EEPA, 1255 23rd St., NW, Washington, DC 20037, (202) 452-1070.

May 4-8: 4th Annual Magnetic Resonance Imaging 1987: National Symposium, Caesars Palace, Las Vegas, NV. Contact: Dept. of Radiology Program Committee, PO Box 17241, Tampa, FL 33682, (813) 873-2090.

### Part II

May 24-29: 11th World Congress on the Prevention of Occupational Accidents and Diseases, International Fairs and Congress Center, Stockholm, Sweden. Contact: Ingvar Soderstrom, Joint Industrial Safety Council, PO Box 22 236, S-10422 Stockholm, Sweden, (8) 229420.

May 27-29: 41st Annual Frequency Control Symposium, Dunfey City Line Hotel, Philadelphia, PA. Contact: Dr. R.L. Filler, U.S. Army ET&D Laboratory, Attn: SLCET-EQ, Fort Monmouth, NJ 07703.

May 28-29: New Technologies: Responding to Future Risks, Worcester Polytechnic Institute, Worcester, MA. Contact: Barbara Guthrie, Worcester Consortium for Higher Education, 37 Fruit St., Worcester, MA 01609, (617) 754-6829.

June 9-11: IEEE MTT-S International Microwave Symposium, Ballys Grand Hotel, Las Vegas, NV. Contact: Dr. R.S. Kagiwada, LRW Associates, 1218 Balfour Dr., Annapolis, MD 21012.

June 12-13: 29th Annual Automatic RF Techniques Group (ARFTG) Conference: Noise Parameter Characterization, Ballys Grand Hotel, Las Vegas, NV. Held in conjunction with the *IEEE MTT-S Conference*. Contact: Richard Irwin, Systems for Automatic Test, 1292 Reamwood Ave., Sunnyvale, CA 94089, (408) 734-9447.

June 14-18: 6th Congress of the European Federation of Societies for Ultrasound in Medicine and Biology (EUROSON), Finlandia Hall, Helsinki, Finland. Contact: Dr. Soren Bondestam, Euroson '87, Vasiniementic 4 B, SF-00200 Helsinki, Finland, (0) 612-1032.

June 15-19: 1987 IEEE AP-S International Symposium and URSI Radio Science Meeting, Virginia Polytechnic Institute and State University (VPI&SU), Blacksburg, VA. Contact: Warren L. Stutzman, Dept. of Electrical Engineering, VPI&SU, Blacksburg, VA 24061, (703) 961-6835.

June 21-25: 9th Annual Meeting of the Bioelectromagnetics Society (BEMS), Red Lion Lloyd's Center, Portland, OR. Contact: BEMS, PO Box 3729, Gaithersburg, MD 20878, (301) 663-4252.

June 21-25: 15th Annual Meeting of the American Society for Photobiology (ASP), Sheraton Bal Harbour, Bal Harbour, FL. Contact: ASP, 1340 Old Chain Bridge Rd., Suite 300, McLean, VA 22101, (703) 790-1745.

July 5-9: 32nd Annual Meeting of the Health Physics Society (HPS), Salt Palace, Salt Lake City, UT. Contact: HPS Secretariat, 1340 Old Chain Bridge Rd., Suite 300, McLean, VA 22101, (703) 790-1745.

July 12-17: 1987 IEEE Power Engineering Society Summer Meeting, Hilton Hotel, San Francisco, CA. Contact: IEEE Society Special Services, 345 East 47th St., New York, NY 10017, (212) 705-7895.

July 14-16: 9th Meeting of the European Society for Hyperthermia Oncology, Cardiff, U.K. Contact: Dr. J.L. Moore, Velindre Hospital, Velindre Rd., Whitchurch, Cardiff CF4 7XL, U.K., (222) 615888.

July 19-24: 8th International Congress of Radiation Research, Edinburgh, Scotland. Contact: Dr. E. M. Fielden, M.R.C. Radiobiology Unit, Harwell, Didcot, Oxon OX11 0RD, U.K., (235) 834393.

July 27-30: 1987 International Microwave Symposium/Brazil, Rio Palace Hotel, Rio de Janeiro, Brazil. Contact: Prof. Alvaro Augusto de Salles, CETUC-PUC/RJ, Rua Marques de Sao Vicente, 225-Gavea-CEP 22453, Rio de Janeiro, Brazil, (274) 9922, ext. 254.

July 28-31: 24th Annual Conference on Nuclear and Space Radiation Effects in Electronics, Snowmass Village, CO. Contact: Prof. Sherra Diehl, North Carolina State University, Dept. of Electrical and Computer Engineering, PO Box 7911, Raleigh, NC 27695, (919) 737-2336.

August 12-16: 1st Symposium on Biological Effects, Hazards and Protection from Non-Ionizing Radiation in Outdoor Applications (NIRO 1987), Wenner-Gren Center, Stockholm, Sweden. Contact: Kreab Congrex, Box 5619, S-1114 86 Stockholm, Sweden, (8) 7234230.

August 17-21: Society of Magnetic Resonance in Medicine (SMRM), New York, NY. Contact: SMRM, 15 Shattuck Sq., Suite 204, Berkeley, CA 94704, (415) 841-1899.

August 24-27: Satellite Symposium on Molecular Electronics and Biocomputers (MEBC), Budapest, Hungary. Contact: MEBC, Roland Eotvos Physical Society, H-1061 Budapest, Ankerkoz 1-3, Hungary.

August 24-September 4: 22nd General Assembly of the International Union of Radio Science (URSI), Hilton and Palace Hotels, Tel Aviv, Israel. Contact: Secretariat, URSI General Assembly, PO Box 50006, Tel Aviv, 61500, Israel, (3) 654571.

August 25-27: 1987 IEEE International Symposium on EMC, Downtown Marriott, Atlanta, GA. Contact: Hugh Denny, Georgia Tech Research Institute, Atlanta, GA 30332, (404) 894-3535.

August 31-September 2: 22nd Annual Microwave Power Symposium: A Macro View of Microwaves and RF Heating, Hyatt Regency Hotel, Cincinnati, OH. Contact: International Microwave Power Institute (IMPI), 13542 Union Village Circle, Clifton, VA 22024, (703) 830-5588.

September 1-5: 9th International Symposium on Bioelectrochemistry and Bioenergetics, Szeged, Hungary. Contact: Dr. Lajos Keszthelyi, Institute of Biophysics, Biological Research Center, Hungarian Academy of Sciences, PO Box 521, H-6701, Szeged, Hungary.

September 7-10: 17th European Microwave Conference, Ergife Palace Hotel, Rome, Italy. Contact: Microwave Exhibitions & Publishers, Ltd., 90 Calverley Rd., Tunbridge Wells, Kent TN1 2UN, U.K.

September 10-11: International Conference and Workshop on Electromagnetic Interference and Compatibility, Bangalore, India. Contact: Dr. G.R. Nagabhushana, Dept. of High Voltage, Indian Institute of Science, Bangalore 560 012, India, (812) 364411 ext. 376.

September 22-24: Test, Measurement and Inspection for Quality Control Conference and Exhibition, Cobo Hall, Detroit, MI. Contact: Tower Conference Mgmt. Co., 331 W. Wesley St., Wheaton, IL 60187, (312) 668-8100.

September 28-30: AC/DC Transmission Interactions and Comparisons Symposium, Boston, MA. Contact: CIGRE, 112 Boulevard Haussmann, 75008 Paris, France, (1) 45-22-65-12.

September 29-October 1: 2nd National Convention of the Society of Broadcast Engineers (SBE), St. Louis Convention Center, St. Louis, MO. Contact: SBE National Convention, PO Box 16861, St. Louis MO 63105, (314) 725-2184.

October 11-14: 7th Annual Meeting of the Bioelectrical Repair and Growth Society (BRAGS), Holiday Inn Downtown, Toronto, Ontario, Canada. Contact: BRAGS, PO Box 64, Dresher, PA 19025, (215) 659-5180.

October 14-16: 9th International Colloquium on the Prevention of Occupational Risks due to Electricity, Hotel Melia Castilla, Madrid, Spain. Contact: Berufsgenossenschaft der Feinmechanik und Elektrotechnik, Gustav-Heinemann-Ufer 130, D-5000 Kohn 51, Federal Republic of Germany, (221) 37781.

October 19-21: International Radar Conference, London, U.K. Contact: Conference Services, IEE, Savoy Pl., London WC2R 0BL, U.K., (1) 240-1871, ext. 222.

November 2-5: DOE/EPRI Review of Research on Biological Effects of 50/60 Hz Electric and Magnetic Fields, Air Ions and Ion Currents, Hyatt Regency Hotel, Kansas City, MO. Contact: W/L Associates, Suite #4, 120 West Church St., Frederick, MD 21701, (301) 663-1915.

November 9-12: 32nd Annual Conference on Magnetism and Magnetic Materials, Marriott Hotel, Chicago, IL. Contact: Dr. John Scott, American Institute of Physics, 335 East 45th St., New York, NY 10017.

December 13-18: Symposium on Hyperthermia, Boston, MA. Held in conjunction with the ASME Winter Annual Meeting. Contact: Prof. Bob Roemer, Dept. of Aerospace and Mechanical Engineering, University of Arizona, Tucson, AZ 85721, (602) 621-6112.

December 14-18: 12th International Conference on Infrared and Millimeter Waves, Americana Dutch Resort Hotel, Lake Buena Vista, FL. Contact: Kenneth Button, Massachusetts Institute of Technology, PO Box 72, MIT Branch, Cambridge, MA 02139, (617) 253-5561.

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