magnetic fields. This year, MIT is taking its summer school to the University of Stirling outside Edinburgh, Scotland, and Lele is going along. The course will be given from June 10-14; the cost for the week is $1400, which includes tuition, food and lodging (golf may be extra). The deadline for applications is April 15. For those who want to take the course but would prefer not to travel so far, Lele will also offer it at MIT, August 5-9, for $1050. Contact: Director of the Summer Session, MIT, Room E19-356, Cambridge, MA 02139, (617) 253-2101.

POWER LINES

Florida Tumor Cluster... Five girls living near 69 kV power lines developed an extremely rare type of ovarian cancer, endodermal sinus tumors, between 1974 and 1978. Four of the five, who were 1.5 to 18 years old and lived in Jacksonville, FL, died. Writing in *Oncology, 41,* 233, 1984, Drs. T.E. Aldrich, A. Glorieux and S. Castro note that these malignancies are "so rare that virtually no information has been compiled concerning their etiology" and that the cluster "is too remarkable to go unreported." The researchers argue that magnetic fields from the power line may have had a "mutagenic or promoter effect," complementing initiation by lead or polycyclic hydrocarbons from a nearby lead smelter plant and highway. They also raise the possibility that genetics, or some combination of genetic and environmental factors, played a role. (The five girls were black.) They conclude that "the power line hypothesis is only one interpretation and further research is obviously needed."

STANDARDS

IEC on Industrial Equipment EMC... The International Electrotechnical Commission (IEC) has issued two new standards on *Electromagnetic Compatibility for Industrial-Process Measurement and Control Equipment.* Publication 801-1, *Part 1: General Introduction,* which is a very brief overview of the problem, notes that the dominant source of industrial EMI is the walkie-talkie. Publication 801-2, *Part 2: Electrostatic Discharge Requirements,* applies to ESD generated by operators touching industrial equipment and ESD occurring between charged objects near the susceptible equipment — in both industrial and power generating plants. Part 2 establishes a reference test procedure and recommends severity levels. The documents are available from the International Sales Office of the American National Standards Institute (ANSI), 1430 Broadway, New York, NY 10018, (212) 354-3300. Part 1 costs $10.00 and Part 2 costs $29.00, plus postage.

Resources...NBS has released *Standards Activities of Organizations in the United States,* (SP-681). The directory summarizes the work of more than 750 organizations in the U.S., including federal and state agencies and more than 400 private groups. It is available, prepaid, for $13.00 ($16.25 foreign) from the Government Printing Office, Washington, DC 20402. Order No. 003-003-02602-6....The January 1985 issue of the *IEEE Communications Magazine* features a number of articles on the standards work of the CCITT, IEC, IEEE, ISO and CEPT, with special reference to the structure and operation of these international groups.

VDTs

Legislation... Massachusetts State Senator Gerard D'Amico has introduced the first VDT bill of the new year in the U.S. The measure, which has not yet been assigned a number, requires periodic rest breaks, adjustable furniture and equipment, glare and noise control and semi-annual inspections of computer equipment. Under the bill, an employer would be required to provide, upon request, non-VDT work for a pregnant operator. If alternative work is not available, however, an employer can lay off the worker, who then becomes eligible for unemployment insurance. For more information, contact Barry Berman, Senator D'Amico's office, Room 413A, State House, Boston, MA 02133, (617) 969-7177....In Oregon, Senate Bill 57 would instruct the director of the state Workers' Compensation Department to develop voluntary purchasing and usage rules for VDTs as well as an educational program for VDT workers. The legislation was introduced by the standing Committee on Labor, chaired by Senator Margie Hendriksen, who sponsored Oregon's first VDT bill in 1983. The committee was acting on the recommendation of an interim labor committee, which held a series of meetings in 1984 and issued a report late last year (see *MWN,* November 1984). For copies of the bill and the report, contact Ms. Cheyenne Chapman, Committee on Labor, 331 State Capitol, Salem, OR 97310, (503) 378-5720....A Rhode Island study commission established last fall held a series of public hearings in January. The commission, which includes labor, industry and state representatives, as well as legislators, is planning to report its recommendations to the state assembly in February.

ETC

In the News... The January 14 issue of *The New Yorker* has a short piece on the New York Academy of Sciences' *Conference on Medical and Biological Effects of Light* (see *MWN,* December 1984). The anonymous author focuses on the pineal gland....The February *Omni* features a long article by science writer Kathleen McAuliffe on "The Mind Fields." McAuliffe begins by describing her tour of Dr. Jose Delgado's lab in Madrid, Spain, and goes on to delve into the scientific, medical and political controversies surrounding electromagnetic radiation from power lines, radar, VDTs, etc....Eric Lerner reviews the potential use of pulsed electromagnetic fields (PEMFs) for the treatment of osteonecrosis, osteoporosis and other bone ailments in the January *Esquire.* In the same issue, the magazine's editors present one of *Esquire's* Dubious Achievement Awards for 1984 to Professor Leonard Taylor of the University of Maryland for developing a way of shucking oysters with microwaves.

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VDT Legislative Report

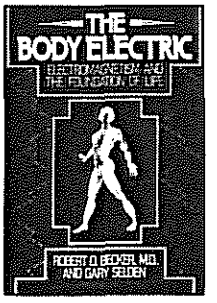
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PEMFs: Project To Verify Delgado-Leal Effect Underway

An international project is underway to determine the extent to which extremely weak pulsed electromagnetic fields (PEMFs) are biologically active. Researchers in Europe and the U.S. are trying to replicate the results obtained by Dr. Jocelyne Leal, who, working in Dr. Jose Delgado's laboratory in Madrid, Spain, showed that magnetic fields many times weaker than the Earth's can profoundly upset the development of chick embryos.

The Delgado-Leal results, first published in 1982, have prompted widespread speculation that low-level magnetic fields may present greater risks to human health than previously suspected. Their experiments are, for instance, often cited by those concerned about the effects of working at video display terminals (VDTs), which emit weak PEMFs from their flyback transformers.

Project coordinator Dr. Thomas Rozzell of the Office of Naval Research (ONR) explained in a telephone interview that the participating labs are not trying to repeat the original experiment exactly because the exposure system will be somewhat different. "We are attempting to *verify* whether the phenomenon Leal originally found is real," he said.

Rozzell and Dr. Michael Marron, also of ONR, have been planning the experiments for the last two years. Rozzell returned last summer from a two-year stint in Europe, where he was in close contact with Leal and with Dr. Kjell Hansson-Mild, of the Swedish National Board of Occupational Safety and Health in Umea, who has been doing research based on the Madrid experiments (see *MWN*, June 1984).

(continued on p.14)

OMB Okays EPA Options for RF/MW Limits

The Environmental Protection Agency (EPA) will soon issue a request for comments on four options to protect the general public from radiofrequency and microwave (RF/MW) radiation. The move follows a six-month review of the options by the Office of Management and Budget (OMB). EPA staffers were cautious about specifying when the options paper would be published in the *Federal Register*, because it must still be approved by senior EPA officials.

Informed sources told *Microwave News* that the agency will ask for advice on four courses of action. Three of these call for public exposure standards based on specific absorption rates (SARs) of 0.04, 0.08 and 0.4 W/Kg. The fourth option is to take no regulatory action.

At the most stringently regulated frequencies, 30-300 MHz, these SARs would result in power density limits of 100, 200 and 1,000 uW/cm^2, respectively. The 1982 American National Standards Institute (ANSI) guidelines are based on a SAR of 0.4 W/Kg.

(continued on p.16)

RF Hot Spots on Cougar Mountain

Three localized hot spots, exceeding the 1 mW/cm² safety limit set by the American National Standards Institute (ANSI), have been identified in publicly accessible areas near an antenna farm on Cougar Mountain outside Seattle, WA. The maximum "spatially averaged" reading in a public space was 700 uW/cm². Radiofrequency (RF) radiation levels on broadcasters' property were generally much higher, often exceeding 1 mW/cm².

The measurements were made by a team from the Environmental Protection Agency (EPA) and the Federal Communications Commission (FCC) last May in response to public concerns over the health effects of RF radiation.

The FCC has asked eight of the ten FM broadcasters using the antenna farm to put up fences and/or post warning signs in order to correct the problem. The commission, which has adopted the ANSI limits as an exposure standard, also warned all ten FM broadcasters that their workers may face radiation health risks.

Some local residents are disturbed by the EPA-FCC findings and believe that the ANSI limits do not provide enough protection. "The FCC's use of the ANSI standard is forcing us to reside with radiation levels that exceed those selected as an occupational limit by the Johns Hopkins Lab, an organization that is free from the pressures of the communications industry," Monty Lennox, who lives near the antenna farm, told *Microwave News*. The Johns Hopkins standard is ten times stricter than ANSI's (see *MWN*, December 1984).

Survey Results

According to EPA's report, spatially averaged power densities exceeded 200 uW/cm² in about 5 percent and 100 uW/cm² in 11 percent of all locations surveyed in publicly accessible areas. Virtually all the measurements exceeded 1 uW/cm², a level which EPA has found is the upper range of exposure for most Americans.

A power level of 700 uW/cm² was measured within 25 feet of an FM radio tower. EPA notes that, although this is below the ANSI limit, it is well above the 200 uW/cm² safety limit adopted or recommended by the International Radiation Protection Association (IRPA), the state of Massachusetts and Multnomah County, OR.

The highest localized level measured was greater than 2.35 mW/cm², near a metal "chinning bar" in a private playground. Readings over 2 mW/cm² and just under 1.7 mW/cm² were taken in an unfenced area near a tower which supports 3 FM transmitters.

The highest spatially averaged and maximum localized fields *inside* homes were 23 and 305 uW/cm², respectively. The 305 uW/cm² reading was for an "unperturbed" field. Near a curtain rod in one bedroom the "perturbed" RF field was 352 uW/cm².

RF fields inside the broadcasters' properties were higher. In one lot with 3 towers supporting 4 FM stations, most of the readings were above 1 mW/cm² and a few exceeded 2 mW/cm². Under normal operating conditions, no one works at the antenna farm full-time, though technicians come to maintain the antennas.

The EPA report notes that, "Although no measurements were taken at elevated locations on the towers, there is no question that a worker who ascends any of the FM towers ...will encounter fields that exceed the ANSI radiation protection guide."

Whole-Body v Partial-Body Exposures

The spatially averaged RF levels are approximations of whole-body exposures, EPA's Richard Tell said in a telephone interview. Tell, who led the measurement team, added that "it is a real issue how to interpret the hot spots."

As Tell's report points out, the localized, perturbed fields "are real and can result in relatively high partial-body exposures." None of the existing standards specify limits for partial-body exposures.

The FCC has raised the problem of occupational exposures with the broadcasters, but has not specified any corrective plan, according to William Hassinger of the commission's Mass Media Bureau. Among the options available are reductions in power, using alternative antennas and shutdowns. "Some of the stations may face tough choices," Hassinger told *Microwave News*.

Other findings of the survey:

- The measured RF levels were far lower than those predicted by EPA models.
- Vegetation, coniferous trees in particular, appears to be a good RF shield.
- FM stations are the only significant source of RF radiation on Cougar Mountain. In addition to the 10 FM antennas, there are several microwave point-to-point dishes and other low-power communication antennas on the 22 towers built on the mountain.
- All the measurements cited in the report were taken within ten feet of the ground, and "it is likely that the power densities increase as one moves to greater heights."

Cougar Mountain residents, who are opposing a Seattle TV station's proposal to construct a new transmitter (see *MWN*, May 1985), have also reported RF interference (RFI). According to the EPA report, "RF levels on virtually the entire mountaintop exceed the blanketing value" set by FCC regulations to protect against RFI. Hassinger said in a telephone interview that the commission does not plan to require stations to reduce the potential for RFI in nearby homes.

The EPA report, *An Investigation of Radiofrequency Radiation Exposure Levels on Cougar Mountain, Issaquah, WA, May 6-10, 1985*, is available from the FCC's duplicating contractor, International Transcription Services, 2100 M St., NW, Washington, DC 20037, (202) 857-3800.

Portland Is Next

The EPA-FCC team is scheduled to go to Portland, OR,

in May for the next series of broadcast radiation measurements. There has been much debate about the health risks of RF radiation in Portland, and the city's Planning Commission recently proposed a 200 uW/cm^2 safety standard for public exposures (see *MWN*, July/August and November/December 1985).

The FCC had hoped to measure radiation levels at two or three sites in 1986, but those plans are now uncertain in light of budget cuts forced by the Gramm-Rudman deficit reduction act. Travel funds have been slashed and one FCC staffer said that even the trip to Portland may no longer be possible.

NIOSH VDT Pregnancy Study Plan Rejected by OMB

The federal study of reproductive risks among video display terminal (VDT) users suffered a major setback in December when the Office of Management and Budget (OMB) rejected the research protocol submitted by the National Institute for Occupational Safety and Health (NIOSH). The OMB ruled that the protocol was poorly designed and that its results would not stand up to scientific scrutiny, according to an agency spokesman.

Dr. Teresa Schnorr, who is leading the NIOSH study, is confident that the OMB decision will be overturned. She said that she has already corrected several of the problems cited by the OMB and plans to appeal the December ruling using statements of support from the study's peer review panel. "OMB needs to see the other side of the coin, which will be the point of the appeal," she told *Microwave News*.

The OMB, which is responsible for fiscal oversight of the executive branch of the federal government, broadly criticized the NIOSH protocol on the following counts: (1) inadequate study population size; (2) incorrect definition of the "sampling frame," the statistical method by which the study population was selected; (3) poor definitions of major variables, and (4) inclusion of unnecessary questions in the survey questionnaire. "These deficiencies might lead to spurious correlations that might be incorrectly interpreted," the OMB concluded, noting, nevertheless, that NIOSH had "made a credible case for the conduct of a study." The OMB indicated that it would reconsider the proposal if NIOSH corrects the problems.

Bell South Critique

Bell South, one of two companies set to participate in the study, submitted a harsh critique of the protocol to both the OMB and NIOSH in late November. Prepared for the company by outside consultants, the assessment identified five basic flaws in the plan; three of the five are repeated in the OMB's evaluation, and the OMB's Edwin Dale acknowledged that Bell South's report influenced the agency's decision.

The critique was written by Dr. Brian MacMahon, chairman of the Department of Epidemiology at Harvard University's School of Public Health in Cambridge, MA, and Dr. Sally Zierler of Brown University in Providence, RI. Their analysis bluntly asserts that:

> The likelihood that the study as described will achieve its stated objectives or satisfy the need [to address public concern]...is virtually nil. It is in our view inconceivable that the study would yield results that are definitive, unequivocal or credible and, even with the modifications that we will propose, such results cannot be assured with this study design.

MacMahon and Zierler cited five "critical flaws" in the NIOSH study design: inadequate definitions of pregnancy outcomes; excessive data collection; lack of concern for recall bias and other types of biases; incomplete medical records on pregnancy outcomes, and insufficient population size. They recommended ways to correct many of these flaws and suggested adding a question to the survey on the use of ultrasound during pregnancy. In addition, they urged that other study designs be considered.

Study History

NIOSH first announced its intention to study pregnancy risks among VDT operators in late 1982 and several times has been forced to scale back its research plans, in part

Battelle ELF-Swine Study Out

As we go to press, the Electric Power Research Institute (EPRI) has released the Battelle study on the effects of 60 Hz fields on three generations of miniature swine. The report has been due for some time —the actual experimental research was completed four years ago.

Although most of the results indicated no ill effects, the study did find an increase in malformations and lower body weights among the third generation fetuses, compared to controls.

Microwave News will publish an in-depth report on the Battelle findings — including the controversy over the planned follow-up study — in our next issue.

The seven-volume report covers behavior (No.2), exposure system and dosimetry (No.3), growth, reproduction and development (No.4), hematology and serum chemistry (No.5), immunology (No.6), and neurology (No.7), and includes a summary volume (No.1). The principal investigators were Drs. Richard Phillips and Larry Anderson at Battelle Pacific Northwest Labs in Richland, WA. Phillips is now with the Environmental Protection Agency.

All seven volumes of the report, *Biological Studies of Swine Exposed to 60 Hz Electric Fields* (EA-4318), are available for $197.50. Volumes 1, 5 and 7 cost $32.50 each; the others are $25.00 each. Order from Research Reports Center, Box 50490, Palo Alto, CA 94303, (415) 965-4081.

because of strong objections by Bell South and AT&T, the second company that has agreed to participate (see *MWN*, November 1982, July/August 1983, January/February 1985). The study proposed to OMB would be primarily a retrospective survey of approximately 3,000 women, half of whom used VDTs regularly.

The study's repeated setbacks may now come under congressional scrutiny, adding to NIOSH's difficulties. *Microwave News* has learned that several influential congressmen are concerned about the agency's handling of the study and are conducting preliminary evaluations that could lead to full-scale investigations.

NIOSH documents submitted to the OMB indicate that the budget for the proposed study is considerably larger than previously reported. The annual cost for the two-year project would be approximately $363,000, nearly quadruple the $100,000 budget agency officials have estimated in the past.

TV/VCR Immunity: Progress Report

Manufacturers are designing greater immunity into their televisions and video cassette recorders (TV/VCR) but more progress still must be made, according to a report by an ad hoc committee set up in 1983 to develop voluntary immunity standards for home electronic equipment.

Among the findings of the committee of industry, government and amateur radio representatives are:

- Most television interference (TVI) complaints continue to come from the first and other harmonics of citizens band (CB) radio transmissions at 27 MHz. Federal Communications Commission (FCC) statistics nonetheless show that this type of TVI has been slowly decreasing over the last three years.
- Studies sponsored by the Electronic Industries Association (EIA) indicate that TV/VCR immunity varies considerably with frequency and among manufacturers. The most susceptible frequency is, as expected, the intermediate frequency (IF) at about 43 MHz. (The IF is the frequency to which RF signals are converted by the receiver during amplification.)
- Immunity is being designed into newer TV/VCR models, achieving protection at a lower cost. Shielded antennas are being used more and more.

Into the Antenna & the Chassis

The ad hoc committee addressed two types of TVI: (1) coupled into the antenna and (2) coupled directly into the chassis. In response to the committee's concerns, the EIA developed voluntary standards to guard against both types of interference (see *MWN*, January/February 1985), but the EIA limits have failed to win the support of the American Radio Relay League (ARRL).

With respect to TVI coupled into the antenna, the EIA guidelines are designed to protect against four-watt CB transmissions. The ARRL prefers guidelines 20 dB stronger to protect against amateur radio and higher power (illegal) CB radio signals. Manufacturers counter that the EIA immunity levels are the highest now achievable.

All TV/VCR manufacturers will be expected to meet the EIA standard, and the trade group will survey compliance during 1986. According to the committee report, if the immunity limit is met but the number of consumer complaints does not decrease, a more stringent standard "should be considered."

Manufacturers favor a 1 V/m immunity level against direct radiation in the AM, amateur and CB radio bands, and a 0.3 V/m level at other frequencies. The ad hoc committee believes that these guidelines should be adequate for CB but may not be strong enough for amateur radio signals and suggests that "additional protection may be necessary."

Protection Distances

The committee estimated the distance between a given source of radiation and a TV/VCR beyond which no significant TVI occurs. For a four-watt CB radio, the "protection distance" for TVI coupled into the antenna is about 100 feet. CB harmonics can cause co-channel TVI within a mile. The separation distance for an amateur radio transmitter operating at 1,500 watts is approximately 2,000 feet, but this shrinks to about 700 feet if the power output is lowered to 150 watts.

For TVI coupled into the chassis, the protection distances can be quite large: up to 3.8 miles from 500-watt (40-46 MHz) pagers and 1.5 miles from an AM radio transmitter.

The models are still rough and the committee notes that they must be verified. In a telephone interview, committee Chairman Donald Heirman said that testing the models will be one of the committee's next major efforts.

Recommendations

The ad hoc committee recommends that:

- Not all TV/VCR manufacturers are participating in using the EIA voluntary standards. It is suggested that CEG/EIA [EIA's Consumer Electronics Group] take the necessary steps to ensure that all TV/VCR manufacturers marketing in the United States assess their immunity profile and strive to introduce greater immunity into their products as warranted.
- One of the measures for monitoring TV/VCR complaints is the FCC Field Operation Bureau unconfirmed complaint data. The committee feels that additional work is needed to further identify the nature of the complaints to properly assess whether *confirmed* complaints are increasing or decreasing.
- Since this report provides a significant description of the activity of the voluntary standards work in alleviating the need for regulations, the widest appropriate distribution is suggested.
- The ad hoc committee should be converted to a permanent standing committee of ANS C63 so that continual monitoring of the progress of TV/VCR immunity can be assured.

The ad hoc committee was set up by the American National Standards Committee C63 on Electromagnetic Compatibility following the enactment of the Communications Act Amendments of 1982, which ordered that home electronic equipment be better protected against electromagnetic interference (see *MWN*, September and October 1982). The committee is seeking to develop voluntary standards to forestall mandatory FCC limits.

According to Heirman, this initial report will be followed by others, and the group will continue to meet on an approximately bimonthly schedule.

The members of the ad hoc committee are: Donald Heirman, AT&T Information Systems (chairman); Fred Huber, Jr., IEEE (secretary); Hector Davis, FCC; Harold Gauper, Jr., retired from GE; Frank Rose, FCC; Dr. Ralph Showers, University of Pennsylvania; Eb Tingley, EIA; Hugh Turnbull, ARRL; and Dan Yates, formerly with the FCC.

Those interested in obtaining a copy of *Initial Report: Immunity of Home Entertainment Devices (TV/VCR), December 1985* should contact Fred Huber, Jr., IEEE Standards Office, 345 East 47th Street, New York, NY 10017, (212) 705-7960.

Air Force Recommends 50 V/m Safety Level for VLF from GWEN

The U.S. Air Force has set a 50 V/m guideline for general population exposures to very low frequency (VLF) radiation. The limit is cited in a generic environmental impact statement (EIS) for the Air Force's Ground Wave Emergency Network (GWEN) communication system, which will operate at 150-175 kHz.

The 50 V/m standard was recommended by John Mitchell, chief of the Radiation Physics Branch at the School of Aerospace Medicine at Brooks Air Force Base in Texas. In a telephone interview with *Microwave News*, Mitchell said that the 50 V/m level is "very conservative," but that since GWEN is a very low power system there will be no problem meeting it.

Mitchell said that the 50 V/m exposure level is only intended to apply to GWEN transmitter sites and that exposure standards for other Air Force systems will have to be looked at on a case-by-case basis.

The Air Force standard for VLF occupational exposures is 100 mW/cm^2, the far field equivalent of 614 V/m. In a September 25, 1984 letter to the Air Force's Electronic Systems Division, Mitchell states that he recommended a 50 V/m guideline based on "new research data currently being generated under Air Force contracts," referring to results from the Universities of Utah and Washington that show increased risks of shocks and burns from VLF radiation (see *MWN*, July/August 1985).

The 50 V/m limit is stricter than all other Western standards: the American National Standards Institute's (ANSI) limits are also based on 100 mW/cm^2, though they apply to both workers and the general public (they only cover frequencies down to 300 kHz). The International Radiation Protection Association (IRPA) has recommended a standard of 194 V/m for occupational exposures and 87 V/m for the general public for frequencies from 100 kHz to 1 MHz. On the other hand, the Soviet standard for 30-300 kHz is 25 V/m.

When it is completed in 1989, the $700 million GWEN communication system will consist of up to 125 VLF relay nodes across the continental U.S. and a total of 400 receive and transmit stations. The network is intended to provide reliable communications after a nuclear attack and is designed to survive the effects of electromagnetic pulse (EMP) radiation. In addition, it operates at a frequency low enough to be unaffected by ionospheric disturbances.

According to computer modeling studies run by the Air Force, the 50 V/m limit would be met at between 105 and 151 feet from the antenna. Each GWEN antenna will sit on about 12 acres of cleared, level land.

Environmentalists and disarmament groups oppose the GWEN system. Peter Shelley, an attorney with the Boston, MA, Conservation Law Foundation (CLF), said in a telephone interview that the group may file suits to block construction at several GWEN sites once they are selected.

The Air Force has decided that the GWEN system will cause too little disruption to warrant preparing a full environmental impact statement (see the Air Force's September 6 *Federal Register* notice, 50 *FR* 36464).

A copy of the *Generic Environmental Assessment for the Ground Wave Emergency Network (GWEN)*, April 1985, is available from the Office of Public Affairs, Electronic Systems Division, Hanscom Air Force Base, MA 01731.

Mass. Adopts Sweeping RF/MW Worker Rules; NJ Proposal Due

The Massachusetts Department of Labor and Industries has adopted the most comprehensive regulations in the U.S. to protect workers from radiofrequency and microwave (RF/MW) radiation. The state exposure limits are based on those developed by the American National Standards Institute (ANSI).

Under the rules, which became effective on December 23, all employers installing new sources of RF/MW radiation must notify the state before turning them on. Owners of existing sources have a year to submit data to the Department of Labor and Industries. Among the sources covered are radio, television and radar stations with an input power of greater than 100 watts, RF sealers and heaters, industrial microwave ovens, and diathermy and hyperthermia equipment.

The other key elements of the state standard are:

- The prohibition of RF shocks and burns even in cases where the exposure standards are not exceeded;
- The designation of an "RF Safety Officer" by each employer using radiation equipment;
- The extension of the standard down to 10 kHz even

though the ANSI guidelines cut off at 300 kHz;

• Annual surveys by all employers to check that radiation levels do not exceed the exposure limits — new equipment must be surveyed when it is installed; records must be kept for at least thirty years.

All facilities maintained by the federal government are exempt from the rules, as are amateur radio stations that are licensed by the Federal Communications Commission and hand-held portable and mobile radios with an input power of fewer than seven watts.

Variances are allowed under certain conditions, but worker exposures must never exceed ten times the ANSI values in such cases.

Broadcasters Win Delay

Radio and television broadcasters have asked for and have been granted a waiver from the rules until April 1. According to Frank Archibald of the department's Division of Occupational Hygiene, the broadcasters sought the delay in order to train safety officers, to buy the necessary radiation measuring equipment and to set up record-keeping procedures.

In 1983, Massachusetts became the first state to set an exposure standard for the general public: a level five times more stringent than ANSI's (see *MWN*, September 1983).

For more information, contact Frank Archibald, Division of Occupational Hygiene, Massachusetts Department of Labor and Industries, 1001 Watertown St., West Newton, MA 02165, (617) 727-3982.

New Jersey Proposal Planned

The New Jersey Bureau of Radiation Protection will soon propose adopting the ANSI guidelines as the state's occupational standard. The state has already adopted the ANSI limits for exposures of the general public (see *MWN*, April 1984), and the forthcoming proposal will simply expand those covered to include workers. The New Jersey rule does not contain any of the reporting and surveying requirements specified by the Massachusetts regulations.

A public hearing on the new rules will be scheduled soon, according to Debbie Wenke, the supervisor of non-ionizing radiation programs at the bureau.

The proposal was developed by the Committee on Non-Ionizing Radiation of the New Jersey Commission on Radiation Protection. The committee is chaired by Dr. Fred Sterzer of RCA. In a telephone interview, Sterzer said that he and other members of the committee would prefer national RF/MW radiation standards for occupational and public exposures and only agreed to a state standard when the federal government failed to act.

For more information, contact Debbie Wenke, NJ Bureau of Radiation Protection, 380 Scotch Rd., Trenton, NJ 08628, (609) 292-5891.

Joe Towne Dies

Joe Towne, founder and president of the Radar Victims Network, died on April 8, 1985 in Sacramento, CA, at the age of 66. Towne had been ill for many years — he suffered his last stroke in January 1985 and was in a coma until his death.

From 1957 until retiring in 1966, Towne was an Air Force radar technician aboard an EC-121 Constellation, flying out of McClellan Air Force Base in Sacramento. Towne developed cataracts, heart ailments and a host of other ills. After much legal wrangling, the VA awarded him a 100 percent disability.

In 1969, Towne sued a number of the electronics companies — GE, Litton, Lockheed, Raytheon and RCA — that designed and built the EC-121s. Some offered to settle out of court on the condition that he not divulge the details of the case. Towne refused. Eventually he accepted a $55,000 settlement, but he never shied away from an opportunity to tell people about the money he had received.

There were many other EC-121 radar technicians living near McClellan and, after an informal survey, Towne found that an unusually high percentage had cataracts at an early age. His discovery fueled his concern, and he began warning people about the dangers of microwaves and helping those who had been overexposed.

In 1976, a small group of men, all of whom had serious medical problems, met in Framingham, MA, and formed the Radar Victims Network; Towne was named president. They agreed that they would direct their energies "toward the goal of securing an epidemiological study of microwave injury" and "to try and interest the medical profession in the diagnosis and treatment of microwave injury."

Although these goals were never really attained, the network grew until, at its height, it had more than 150 members. For the rest of his life, Towne served as a clearinghouse for others who thought that they had suffered ill effects from microwave radiation, helping them prepare their VA claims and providing them with moral support.

With Towne gone, the network is largely inactive. A number of the original organizers have died and many others are too sick to do the work. In fact, it took months for word to filter from one member to another that Joe had died.

NCRP Takes On Non-Ionizing Radiation

The National Council on Radiation Protection and Measurements (NCRP), long known for its studies on ionizing radiation, is increasing its activities on non-ionizing radiation. According to NCRP Executive Director Roger Ney, the move follows a decision by the council's board of directors that non-ionizing radiation has become a timely subject in need of greater attention.

Professor Herman Schwan of the University of Pennsylvania in Philadelphia has been invited to present the Taylor Lecture at the NCRP's annual meeting at 5 p.m. on April 2 at the National Academy of Sciences auditorium in Washington, DC. The title of his talk is "Non-Ionizing Radiation Bioeffects: Cellular Properties and Interactions."

Invited papers on extremely low frequency (ELF), radiofrequency and microwave (RF/MW) radiation and ultrasound, as well as briefings on ongoing NCRP studies, will be featured at the April 2-3 meeting. Among the presentations, Dr. Ross Adey will address "Electromagnetic Fields, Cell Membrane Amplification and Cancer Promotion."

Ongoing Studies

Four NCRP scientific committees (SC) are preparing reports on the bioeffects and measurement of electromagnetic radiation:

• **SC53: Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Radiation.** This committee, chaired by Professor Bill Guy of the University of Washington in Seattle, has been at work since 1977. According to Dr. Constantine Maletskos, the staff officer for the committee, the report is now at the printer and an index is in preparation. Maletskos is hopeful that the long-awaited report will be ready for distribution at the April meeting.

The report includes a review of the RF/MW bioeffects literature and recommends exposure standards. In the years in which the report has undergone extensive reviews, word has circulated that the committee has recommended an exposure limit of 200 uW/cm^2 for the general population at the most strictly regulated frequencies. Some sources have reported that the Guy group wavered between a 100 and a 200 uW/cm^2 standard before deciding on the higher limit to reduce the economic impact on the broadcasting industry. Maletskos declined to discuss the conclusions of the report prior to its publication.

In addition to Guy, the other members of the committee are: Drs. Ross Adey, Edward Alpen, Stephen Cleary, Don Justesen, Mary Ellen O'Connor and Richard Phillips. The advisors to the committee are: Drs. Eleanor Adair, Ed Hunt, Sol Michaelson, Harvey Ragan and Charlotte Silverman. The consultants to the committee are: Drs. C.K. Chou, Justus Lehmann, Richard Lovely, Jan Stolwijk and W.A.G. Voss.

• **SC67: Biological Effects of Magnetic Fields.** This committee has been at work for more than five years under the chairmanship of Dr. Dennis Mahlum of the Battelle Pacific Northwest Labs in Richland, WA. No date has been set for completing its report. The members of the committee are: Drs. John Baum, John deLorge, Karl Illinger, Charlotte Silverman and Tom Tenforde. Dr. Tom Budinger is an advisor to the committee on issues related to nuclear magnetic resonance imaging. Dr. Tom Koval is the NCRP staffer working with SC67.

• **SC78: Practical Guidance on the Evaluation of Human Exposures to Radiofrequency Radiation.** SC78 was set up in 1983 under the chairmanship of Richard Tell of the Environmental Protection Agency (EPA) to develop simple guidelines for measuring electromagnetic fields in the 10 kHz to 100 GHz frequency range (see *MWN*, April 1984). According to Tell, a 237-page draft report has been prepared and is now being revised. He plans to submit a final draft for NCRP review this spring. The other members of the committee are: Howard Bassen, Jules Cohen, Dr. David Conover, Dr. Carl Durney and Ron Petersen. Dr. Tom Koval is the NCRP staffer assigned to the project.

• **SC79: Extremely Low Frequency Electric and Magnetic Fields.** SC79 was set up under a $150,000 contract from the EPA in 1983 (see *MWN*, December 1983). According to committee Chairman Dr. Adey of the VA Hospital in Loma Linda, CA, a draft report should be forwarded to the NCRP by the end of 1986. The other members of the committee are: Drs. Carl Blackman, David Carpenter, Charles Ehret, William Feero, Richard Lovely, Genevieve Matanoski, Martin Misakian and Richard Phillips. Maletskos is the NCRP staff officer for the study.

VDTs

In the latter half of 1985, the NCRP set up an ad hoc group to look into the question of video display terminals (VDTs), under the chairmanship of Dr. George Wilkening of AT&T Bell Labs. The other members of the VDT group are Drs. Ed Alpen and Bill Guy. According to NCRP's Koval, the ad hoc group has no plans to issue a report, but may issue a statement if it deems one necessary. Wilkening will discuss the group's work at the meeting.

Completed Studies

Two NCRP studies on non-ionizing radiation have already been published:

• **Report No.67: Radiofrequency Electromagnetic Fields: Properties, Quantities and Units, Biophysical Interaction and Measurements** was issued in 1981. It was prepared by a committee chaired by Bell Labs' Wilkening (see *MWN*, October 1981). Price: $13.00.

• **Report No.74: Biological Effects of Ultrasound: Mechanisms and Clinical Implications** was issued in 1983. It was prepared by a committee chaired by Dr. Wesley Nyborg of the University of Vermont in Burlington. Price: $16.00.

These reports can be ordered from NCRP Publications, Suite 1016, 7910 Woodmont Ave., Bethesda, MD 20814, (301) 657-2652. The prices include postage and handling.

RF Exposures: FCC's Advisory Guidance to Broadcasters

Reprinted below are excerpts from the Federal Communications Commission's (FCC) Further Guidance for Broadcasters Regarding Radiofrequency [RF] Radiation and the Environment, *which was released on January 28. The commission previously had issued a technical bulletin,* Evaluating Compliance with FCC-Specified Guidelines for Human Exposure to RF Radiation *(Office of Science and Technology (OST) Bulletin No.65). This* Further Guidance *gives broadcasters general instructions for compliance with the commission's rules on human exposures to RF radiation under the National Environmental Policy Act (see* MWN, *April and September/October 1985).*

...As of January 1, 1986, all applications for new facilities, modifications to existing facilities and renewals must contain *either* a specific indication that the RF radiation of the particular facility or operation will not have a significant environmental impact *or* an environmental assessment which will serve as the basis for further Commission action....

Most broadcasting facilities produce high RF radiation levels at one or more locations near their antennas. That, in itself, does not mean that the facilities significantly affect the quality of the human environment. Each situation must be examined separately to decide whether humans are or could be exposed to high RF radiation. Paragraph 37 of the *Report and Order* [50 *FR* 11151, March 20, 1985] points out that accessibility is a key factor in making such a determination. As a general principle, if areas of high RF radiation levels are publicly marked and if access to such areas is impeded or highly improbable (remoteness and natural barriers may be pertinent) then it may be presumed that the facilities producing the RF radiation do *not* significantly affect the quality of the human environment and do not require the filing of an environmental assessment.

Because we wish to avoid burdening applicants with unnecessary work, expenses and administrative filings, we offer the following guidance as to how we will view typical situations. The term "high RF level" means an intensity of RF radiation, whether from single or multiple sources, which exceeds the ANSI guidelines.

Situations

(A) High RF levels are produced at one or more locations above ground level on an applicant's tower:

If the tower is marked by appropriate warning signs, the applicant may assume that there is no significant effect on the human environment with regard to exposure of the general public.

(B) High RF levels are produced at ground level in a remote area not likely to be visited by the public:

If the area of concern is marked by appropriate warning signs, an applicant may assume that there is no significant effect on the human environment with regard to exposure of the general public. It is recommended that fences also be used where feasible.

(C) High RF levels are produced at ground level in an area which could reasonably be expected to be used by the public (including trespassers):

If the area of concern is fenced *and* marked by appropriate warning signs, an applicant can assume that there is no significant effect on the human environment with regard to exposure of the general public.

(D) High RF levels are produced at ground level in an area which is used or is likely to be used by people and to which the applicant cannot or does not restrict access:

The applicant must submit an environmental assessment. This situation may require a modification of the facilities to reduce exposure or could lead to a denial of the application.

(E) High RF levels are produced in occupied structures, on balconies or on rooftops used for recreational or commercial purposes:

The applicant must submit an environmental assessment. The circumstances may require a modification of the broadcasting facility to reduce exposure or could lead to a denial of the application.

(F) High RF levels are produced in offices, studios, workshops, parking lots or other areas used regularly by station employees:

The applicant must submit an environmental assessment. The circumstances may require a modification of the facilities to reduce exposure or the application may be denied. This situation is essentially the same as (E). We have included it to emphasize the point that station employees as well as the general public must be protected from high RF levels. Legal releases signed by employees willing to accept high exposure levels are not acceptable and may not be used in lieu of corrective measures.

(G) High RF levels are produced in areas where intermittent maintenance and repair work must be performed by station employees or others:

ANSI guidelines also apply to workers engaged in maintenance and repair. As long as these workers will be protected from exposure to levels exceeding ANSI guidelines, no environmental assessment is needed. Unless requested by the Commission, information about the manner in which such activities are protected need not be filed. If protection is not to be provided, the applicant must submit an environmental assessment. The circumstances may require corrective action to reduce exposure or the application may be denied. Legal releases signed by workers willing to accept high exposure levels are not acceptable and may not be used in lieu of corrective measures.

The foregoing also applies to high RF levels created in whole or in part by reradiation.

A convenient rule to apply to all situations involving RF radiation is the following:

(1) Do not create high RF levels where people are or could reasonably be expected to be present *and*

(2) Prevent people from entering areas in which high RF levels are necessarily present.

Fencing and warning signs may be sufficient in many cases to protect the general public. Unusual circumstances, the presence of multiple sources of radiation and operational needs will require more elaborate measures.

Intermittent reductions in power, increased antenna heights, modified antenna radiation patterns, site changes or some combination of these may be necessary, depending on the particular situation.

For further discussion see Office of Science and Technology Bulletin No.65, *Evaluating Compliance with FCC-Specified Guidelines for Human Exposure to Radiofrequency Radiation,*

October 1985. Copies of this bulletin may be ordered from the National Technical Information Service, [Springfield, VA 22161], (800) 336-4700, Order No.PB 86-127081 [$11.95].

For further information regarding this *Notice* applicants should contact the AM Branch, FM Branch, TV Branch or LPTV/ Translator Branch, as appropriate.

ANS C95 on ELF Exposure Standards

At a meeting held in July 1984, the American National Standards (ANS) Committee C95 on Non-Ionizing Radiation Hazards asked Dr. Richard Phillips of the Environmental Protection Agency (EPA) in Research Triangle Park, NC, to set up an ad hoc committee to consider the merits of an exposure standard for extremely low frequency (ELF) radiation (see MWN, *October 1984). Reprinted below is Phillips's report, sent to Professor Saul Rosenthal, chairman of C95, on June 14, 1985. Standing Subcommittee C95.IV addresses "Safety Levels and/or Tolerances with Respect to Personnel."*

Dear Professor Rosenthal:

At the ANS C95.IV meeting held at the Omni Hotel in Atlanta, GA, on July 15, 1984, you requested I form and head up an Ad Hoc Committee to investigate the feasibility of expanding the frequency range of ANS C95.IV to include ELF electromagnetic radiation: of particular interest was 60 Hz electric and magnetic fields from power generation and distribution systems. It is my understanding that this Ad Hoc Committee was formed in response to a request by Dr. Charles. L. Wagner, President of the IEEE Power Engineering Society (PES).

In response to your charge, I formed a committee consisting of four scientists with extensive knowledge in the subject area: Dr. William Wisecup, Aerospace Corporation, quality assurance monitor of DOE, New York and EPRI projects dealing with the biological effects of 60 Hz electric and magnetic fields; Dr. H.B. Graves, Pennsylvania State University, a scientist who has been active in investigating the biological effects of 60 Hz electric fields since the early 1970s; Dr. William Feero, private consultant, a member of the IEEE/PES and founder of the DOE research program on the biological effects of 60 Hz electric and magnetic fields; and Dr. Jack Lee, Bonneville Power Administration, who heads up the BPA research program on the environmental impact of power transmission lines.

Primary sources of biological information for our assessment came from peer-reviewed published papers in the literature, technical reports and four recent critical reviews in the literature:

1.*Environmental Health Criteria 35: Extremely Low Frequency (ELF) Fields,* World Health Organization, 1984.

2.*The Health and Safety Effects of High Voltage Transmission Lines,* Report of a Joint Subcommittee, Senate Document No.11, Commonwealth of Virginia, Richmond, VA, 1985.

3.*Biological and Human Health Effects of Extremely Low Frequency Electromagnetic Fields: Post-1977 Literature Review.* American Institute of Biological Sciences, Arlington, VA, March 1985.

4.*Biological Effects of 60 Hz Power Transmission Lines.* A Report of the Florida Electric and Magnetic Field Science Advisory Commission, Florida Electric Power Coordination Group, Tampa, FL, March 1985.

The information contained in these four critical reviews represents the views of the majority of scientists who are active in this area of research, and decision makers who are concerned with the impact of ELF electromagnetic fields on the environment and life forms, particularly human beings....

In general, the conclusion of these reviews is that there is no reliable and documented evidence that exposure to ELF electric and magnetic fields of the range encountered in the vicinity of ELF radiation sources (i.e., 50/60 Hz transmission lines, ELF communication systems) causes significant or adverse biological reactions in human beings. However, a number of caveats are stated with these conclusions:

1. Exposure to electric and/or magnetic fields in the ELF can cause a variety of effects at any of several levels of biological organization in animals and in vitro systems, but interpretation of these data and extrapolation to human beings is not possible at this time.

2. Results from clinical, mortality and epidemiological studies are inconsistent and inconclusive, but call attention to the need for well conducted studies on the cancer incidence and exposure to low-level magnetic fields.

3. Additional research is needed before data derived from laboratory studies on animals can be extrapolated to potential effects on human beings.

Major issues of concern are the reported correlations between ELF radiation and cancer (mortality and epidemiological studies), alterations in fetal development, disruption of normal circadian rhythmicity, alteration in neural function, and cellular/membrane effects with low-level exposures at windows in frequency and amplitude.

The question as to whether or not sufficient information exists to require and establish a safe exposure guideline is debatable. Debates on this issue to date have been occurring among scientists, and within legal proceedings dealing with rights-of-ways for high voltage transmission lines. No vehicle has been established to date for a gathering of interested and impacted individuals and groups to discuss, debate and hopefully resolve the issue concerning the safety aspects of ELF radiation. It is our opinion that ANS C95.IV might be the appropriate vehicle. There is a need for scientists, regulators, producers, users and the general public to discuss the issue in an open forum such as ANS C95.IV. Major issues that need to be discussed are:

1. What is our current state of knowledge?
2. Is there a risk associated with exposure to ELF radiation? If so, at what level and duration of exposure?
3. Are safe exposure guidelines needed?
4. Is there sufficient information to establish safe exposure guidelines?
5. What will be the impact of an exposure guideline on energy production, distribution and costs?
6. If a risk exists, is it greater than the benefits?
7. Can a consensus be reached among concerned parties?

Whether or not ANS C95.IV should take on the responsibility and lead role on this issue needs to be discussed at the ANSI meeting in June in San Francisco. It should be noted that action is being taken by regulators in several states, and NCRP has formed a committee to address this issue. To date EPA has not been authorized to produce an exposure guideline for ELF radiation, but has initiated research on biological effects of ELF radiation.

Sincerely yours,
Richard D. Phillips

UPDATES

BIOLOGICAL EFFECTS

PEMFs Stimulate Tumor Cells... Pulsed electromagnetic fields (PEMFs) can promote the growth of embryonal carcinoma (EC) cells and inhibit their differentiation, according to a report from Kagoshima University in Japan. Dr. Takuya Akamine and coworkers exposed the EC cells for 84 hours to rectangular-shaped pulses with a width of 130 microseconds and a frequency of 100 Hz. The field was either 1 gauss and 5 V/m or 10 gauss and 53 V/m; both levels caused significant changes. The researchers do not know the mechanism by which the PEMFs inhibit cell differentiation — whether it is the magnetic field itself or the induced current. They note that their results suggest that the PEMFs may be interfering with the later stages of cell differentiation and that the inhibitory effect is consistent with the Delgado-Leal papers on the action of PEMFs on chick embryos. The authors warn that the "application of PEMF[s] in the treatment of malignant tumors should be performed with the greatest caution." Their paper appears in the August issue of the *Journal of Cellular Physiology*, pp.247-254.

UV-A and DNA... Near-ultraviolet (UV), or UV-A, radiation (320-420 nm), long believed to be benign, may affect DNA in ways that "could have far-reaching, harmful effects on cells," according to Drs. Meyrick Peak and Jennifer Peak of the Argonne National Laboratory (ANL) in Argonne, IL. The Peaks have found that UV-A can cause single-strand breaks (breaking the backbone of the DNA molecule) and DNA-to-protein crosslinks (creating a strong covalent bond between them). In a discussion of their findings in the autumn 1985 *Logos*, an in-house ANL publication, they hypothesize that UV-A "starts chains of chemical reactions that somehow trap and pass on energy in a form that allows a portion of it, through random diffusion and decay, to damage DNA." One possible pathway is through "sensitizing" molecules like porphyrins (which are parts of hemoglobin and chlorophyll) that absorb the radiation and transfer it to molecular oxygen, exciting it to electronically reactive forms which migrate through the cell before decaying. If the excited species come near DNA when they decay, the energy released can cause breaks and crosslinks. The Peaks suspect that, because living cells have been exposed to UV-A for millions of years, mechanisms have evolved to offset its effects. *Logos* is available from the Office of Public Affairs, ANL, 9700 S. Cass Ave., Argonne, IL 60439.

Club Med Dermatitis... First there were supermarket workers who developed rashes after touching fruits and vegetables, and then school children who used limes in art class developed a similar condition (see *MWN*, March and September/October 1985). Now comes the latest example of photodermatitis: "Club Med Dermatitis." Writing in the January 30 *New England Journal of Medicine*, Dr. Wain White of the New York University Medical Center in New York City tells of a tender rash on both thighs of a patient who had just returned from a Caribbean vacation. White attributed the rash to a Club Med "drinking game, during which participants would balance and roll limes up and down their laps and closed thighs." The limes probably secreted furocoumarins, which were then activated by sunlight.

COMPATIBILITY & INTERFERENCE

Power Transients Software... The Electric Power Research Institute (EPRI) has published the *Electromagnetic Transients Program (EMTP) Primer*, a manual for users of the EMTP software program, developed by the Bonneville Power Administration and several other utility and academic groups over the last 15 years to help utilities run inexpensive in-house analyses of high-speed power system transients. The software is complex and difficult to learn — hence the need for a tutorial. The EPRI primer, prepared by S.F. Mauser and T.E. McDermott of Westinghouse's Advanced Systems Technology Division in Pittsburgh, PA, is written for electrical engineers and assumes a working knowledge of both transients and computer simulation. It includes eleven detailed cases as teaching examples. The primer is only one of a number of EPRI initiatives now underway to improve the EMTP. These include a revised version of the program itself, a workbook for new users and a users group hotline. The primer, Report No. EL-4202, is available for $40.00 from the Research Reports Center, PO Box 50490, Palo Alto, CA 94303, (415) 965-4081.

Electroexplosives... The Applied Physics Lab at the Franklin Research Center in Philadelphia is a focal point for the study of explosive devices and their associated electrostatic and electromagnetic hazards. The center offers training courses, publishes a newsletter and organizes a symposium every two-and-a-half years. The *Electroexplosives Devices Training Course: "Hands On" Applications* will be offered May 13-15 and October 14-16 and costs $475. A week-long course, the *Joseph McLain Memorial Seminar on Explosives and Pyrotechnics*, which is very similar to the shorter course but offers more emphasis on chemistry, will be given August 18-22 and costs $650. Both courses will be held in Philadelphia. The four-page newsletter, *explosives and pyrotechnics*, is published monthly and is available by subscription for $40 a year. The *13th Symposium on Explosives and Pyrotechnics* will be held at the Hyatt on Hilton Head Island, SC, December 2-4. For more information, contact Ramie Thompson, Applied Physics Lab, Franklin Research Center, Philadelphia, PA 19103, (215) 448-1555.

COMPUTERS

PC Aides... Computer programs are now available for analyzing radar patterns, designing antennas and planning point-to-point microwave transmission lines on IBM and IBM-compatible personal computers (PCs). Technology Service Corp. (TSC) has developed a "Radar Workstation" so that engineers can calculate and analyze radar patterns at their desks without using large mainframes or time-sharing computers. The software can simulate vari-

ables that affect radar accuracy and range, using color graphics. The price is $4,900.00; the package includes five diskettes, two volumes of documentation and a reference text. For more information, contact TSC's Jan Berkow, Suite 600, 962 Wayne Ave., Silver Spring, MD 20910, (800) 638-2628, or (301) 565-2970 in MD....Dr. David Pozar has written 19 programs for designing and analyzing antenna patterns. The programs, which can be run on either an IBM PC or a DEC PRO/35, cover wire, array and aperture antennas. *Antenna Design Using Personal Computers* gives the full programs in BASIC, as well as an explanation of the theoretical bases for the calculations. A final chapter is devoted to six design case studies. The volume is available for $40.00 from Artech House, Inc., 610 Washington St., Dedham, MA 02026, (617) 326-8220. You can also get all the programs for either computer on a diskette for $44.00....H2A Communications is marketing a *Microwave Transmission Planner,* a software package "designed to speed and improve the design of point-to-point and point-to-multipoint microwave transmission systems through its path analysis, route design and equipment configuration sections." The program can be used on an IBM PC as well as on Hewlett-Packard Series 80 computers. It is available for $695.00 from H2A Communications, SW 310 Skyline Dr., PO Box 146, Pullman, WA 99163, (509) 334-5165.

EMP

Medical Devices... The U.S. Army Medical R&D Command has awarded two contracts for studies on the "Protection of Medical Equipment Against Electromagnetic Pulse (EMP)": $77,600 to John Klebers of IRT Corp. in Vienna, VA, and $36,400 to Ralph Wheeler of Jaycor Corp. of San Diego, CA. Both research projects, sponsored under Phase I of the DoD's Small Business Innovation Research program, are scheduled to be completed by this spring. If the findings are promising, further support may be forthcoming in FY87 under Phase II of the program.

GOVERNMENT

EPA Lab Holds On... The outlook for the EPA's bioeffects research group in North Carolina has improved — a little. The details change from one moment to the next, but at press time the situation is as follows... As we reported in our September/October issue, Congress blocked the agency from closing down its non-ionizing research program in EPA's Experimental Biology Division until the end of December; that decision was a compromise between Senator Albert Gore, Jr. (D-TN), who wanted the work to continue, and Senator Jake Garn (R-UT), who tried to cut it out of the budget to reduce the deficit. In mid-December, a meeting was organized by a senior aide at the Senate Appropriations Committee who was confused that, while the EPA was acquiescing to Administration moves to disband the research group, industry lobbyists, from the National Association of Broadcasters, among others, were writing letters to have it reinstated. As a result of this and other deliberations, congressional staffers told EPA to keep the research program at FY85 levels through FY86, but then failed to provide the necessary manpower and $1.5 million funding. After more compromises, the research program on ELF, RF and MW radiation was allotted $650,000 and the equivalent of about seven man-years. "That is the money I need to close out the program," Dr. Richard Phillips said in a telephone interview. In January, the EPA began reorganizing its Health Effects Research Lab: most of the Experimental Biology Division has been absorbed into the new Cellular and Reproductive Toxicology Division. Phillips, the director of the defunct division, is now the head of the new, larger one. Most of those working on non-ionizing radiation are now members of the new division's Cell Biology Branch, which is headed by Dr. Joe Elder. On the brighter side, Phillips said that the agency has approved the continuation of Dr. Carl Blackman's work on the effect of low-level fields on calcium and a long-planned study on the impact of lifetime, low-level exposure. There have been some losses, however: Drs. Christopher Gordon and James Kinn have been completely moved out of radiation research, and everybody in the division will now be devoting some of their time to chemical toxicology. Soon the FY87 budget cycle will begin, and once again, sources say, there will be no money for non-ionizing radiation research. A sense of hopelessness is setting in. After years of fighting program cuts, the EPA team is discouraged and may finally do what the Administration wants — fade away.

CDRH Committee Nominations... The FDA's Center for Devices and Radiological Health (CDRH) is inviting nominations for a number of its advisory committees, including the Medical Radiation Advisory Committee (MRAC), the Radiologic Devices Panel (RDP) and the Technical Electronic Product Radiation Safety Standards Committee (TEPRSSC). The MRAC studies general policy questions concerning the use of diagnostic radiation. It is primarily involved with devices that use ionizing radiation. Dr. Donald Hamilton, executive secretary of the MRAC, told *Microwave News* that the committee has no plans at present to look into devices that use non-ionizing radiation. The RDP reviews and evaluates data on the safety and efficacy of medical devices now in use. The panel reviews and approves applications for a host of devices, including NMR imagers and hyperthermia units. The TEPRSSC advises on the feasibility and desirability of performance standards to control radiation emissions from electronic products such as microwave ovens, color televisions, diagnostic X-ray equipment and lasers. The committee has been inactive for a long time, but CDRH's Kay Levin said in a telephone interview that there is a strong possibility that the TEPRSSC will meet again in the fall. It has 15 vacancies — five from federal and state government agencies, five from affected industries and five from the public, at least one of whom must be from organized labor — and Levin encouraged those interested to submit their applications as soon as possible. For more information on the

types of experts the FDA is seeking and on when the committee vacancies are expected, see the December 13 *Federal Register* (50 *FR* 50960); or contact the executive secretaries of the groups: Dr. Donald Hamilton, MRAC, (301) 443-2436; Dr. Robert Phillips, RDP, (301) 427-7544; and Arlene Underdonk, TEPRSSC, (301) 443-3426.

MEDICAL APPLICATIONS

Fonar Setback...A federal jury's finding that Technicare Corp., a Johnson & Johnson subsidiary, had infringed on a Fonar patent in making nuclear magnetic resonance imaging (MRI) systems has been set aside by the judge. U.S. District Court Judge Robert Keeton in Boston, MA, held that the Fonar patent was valid, but rejected the contention that Technicare had violated it. Roger Hampton, director of communications for Fonar, told *Microwave News* that the ruling was only a "minor setback" and that the company fully expects the judge's ruling to be reversed. Fonar is planning to take its case to the U.S. Court of Appeals in Washington, DC. Even with this setback, Fonar anticipates a profit on revenues of $40 million for the year ending in June 1986. The company anticipates shipping one imager per week this year, each priced at $1.5 million.

MEETINGS

IEEE "Supermarket"... The IEEE is experimenting with a plan to bundle conferences together, enabling researchers to attend several meetings simultaneously. The first such event, *MONTECH'86,* will be held September 29-October 3, 1986 in Montreal, Canada, and will include conferences on electrothermal processes, antennas and communications, HVDC power transmission and AC power systems. Len Ruggins, president of IEEE Conferences Montreal, Inc., explained that the bundling is designed to aid attendees who must come long distances — admission to one conference entitles you to go to them all. "We wanted to create a supermarket of conferences," he said. The clustering also enables the IEEE to try out new conference ideas without taking large financial risks, since the cost of adding additional meetings is marginal. The early response to MONTECH'86 is encouraging, Ruggins noted, with a surprising number of people from Europe and South America expressing interest. For more information, see the Conference Calendar.

Antennas in Japan... The proceedings of the *1985 International Symposium on Antennas and Propagation* held in Kyoto, Japan, last August are now available. The proceedings cover more than 280 papers in 1,200 pages — printed in three volumes. Copies are available for $165.00, including surface postage, from Myu Research, 2-32-3-303 Sendagi, Bunkyo-ku, Tokyo 113, Japan.

MILITARY SYSTEMS

Alaskan OTH-B... The U.S. Air Force is preparing an environmental impact statement for a new over-the-horizon backscatter (OTH-B) radar in Alaska. The proposed locations for the transmitter and receiver sites are in the southern, interior part of the state, with the operations center to be at Elmendorf Air Force Base. The antenna for the radar will be between four and nine thousand feet long. Public meetings were scheduled to be held in Anchorage and Fairbanks in January 1986. For more information, contact Colonel James Lee, OTH-B Program Office, Electronic Systems Division, Hanscom AFB, MA 01731.

OCCUPATIONAL HEALTH

Stress Among Locomotive Engineers... The Brotherhood of Locomotive Engineers (BLE) is trying to explain why Amtrak engineers operating electrified trains, as well as those regularly working out of New York City and Washington, DC, are experiencing greater stress than other train engineers. The union attributes the finding of increased stress to studies by Drs. Brian Blake and Erika Wick of Decision Dynamics, based in Solon, OH, but Amtrak disputes the contention of differential stress. (At least part of the argument between Amtrak and the BLE centers on the union's desire to have two engineers on each locomotive, while Amtrak only wants one.) In a report prepared by the BLE's Director of Research Thomas Pontolillo, the union suggests that some of the stress is caused by exposure to electromagnetic fields and calls for further physiological and epidemiological research. According to the report, these fields come from overhead power lines, some of which run the train and some of which have been placed along the railroad right-of-way by electric utilities, and from generators and transformers in the locomotives themselves. Pontolillo notes that engineers operating out of New York and Washington, DC, have average stress scores that are 16 and 7 percent above the overall average, respectively, and that engineers operating only electric trains have stress levels that average 9 percent above the average, while engineers operating only diesel engines average 27 percent below the average. The report, *Locomotive Engineer Stress and the Effects of Electromagnetic Radiation,* is available from Pontolillo, BLE, Suite 501, The Craddock Bldg., 146 Rt. 130, Bordentown, NJ 08505, (609) 298-3006.

OVENS

CU Reviews... Compacts and subcompacts are hailed as "The New Wave in Microwave Ovens" by *Consumer Reports* (November 1985). Of the 18 models tested for capacity, cooking speed and ease of use, the GE "Spacemaker II" oven line was recommended, with suggested prices from $235 to $295. Consumers Union (CU) favored the "Micro-Go-Round," a $40 removable, windup turntable, over built-in turntables. Also featured in the article is an item about radiation leakage. CU tests showed that none of the models emitted more than 0.5 mW/cm^2 — below the federal emission standard of 1 mW/cm^2 for new ovens and 5 mW/cm^2 for used ones. In tests run in 1981, CU found that at four feet from the oven, radiation levels averaged 10 uW/cm^2. Nevertheless, citing "Murphy's Law," CU recommends that door seals should always be kept clean and that pregnant women should not linger near ovens while they're turned on.

POWER LINES

Virginia Report... The Virginia Department of Health has found that none of the research published between August 1984 and September 1985 has influenced its assessment that high voltage transmission lines are not hazardous. In its first annual report to the state General Assembly, the department finds that "it is unlikely that electric and magnetic fields associated with [the power] lines give rise to significant health consequences," though noting that there are "some ambiguities" in the literature that preclude a categorical conclusion that "no public health problem will ever arise." The 12-page report, *Monitoring of Ongoing Research on the Health Effects of High Voltage Transmission Lines,* finds that research suggesting that electric fields can alter "certain cellular, physiological and behavioral events" cannot be extrapolated to humans at the present time. With respect to recent papers suggesting a link between electromagnetic exposure and cancer, the report states that the "studies are only suggestive, highly controversial and the results reported are contradictory and do not confirm a causal relationship." The report was required by Senate Joint Resolution No.126, which was approved by the legislature in 1985 (see *MWN,* May 1985). It was prepared by Dr. Khizar Wasti of the Virginia Department of Health's Bureau of Toxic Substances Information in Richmond and released last fall. For more information, contact Ms. Terry Mapp Barrett, Division of Legislative Services, General Assembly Bldg., 910 Capitol St., PO Box 3-AG, Richmond, VA 23208, (804) 786-3591.

AC Line Effects... The IEEE Power Engineering Society (PES), in a recently published report for non-specialists, concludes that there is no evidence of long-term health hazards from AC transmission lines but cautions nonetheless that effects may have thus far "escaped detection" because "meaningful scientific studies have only recently begun." The 62-page report, *Corona and Field Effects of AC Overhead Transmission Lines: Information for Decision Makers,* was prepared in response to increasing public debate over biological effects, EMI and other environmental impacts. It advises that limits set to control radio and TV interference are likely to be of "restricted" use "because limit setting has to recognize the statistical nature of both signals and interference along with many local factors." Developed by the corona and field effects subcommittee of the PES's Transmission and Distribution Committee, the document is a complement to a 1983 brochure, *Electrical Effects of AC Power Transmission Lines.* To obtain a free copy of the PES report, contact Nancy Heitmann, IEEE, 345 East 47th St., New York, NY 10017, (212) 705-7893.

STANDARDS

CISPR & IEC... The International Electrotechnical Commission's (IEC) Special Committee on Radio Interference (CISPR) has published two new standards for conducted and radiated EMI: (1) *Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment,* CISPR Publication 22, first edition, 1985, prepared by Subcommittee B: Interference from ISM RF Apparatus, ($22.00); and (2) *Limits and Methods of Measurement of Radio Interference Characteristics of Household Electrical Appliances, Portable Tools and Similar Electrical Apparatus,* CISPR Publication 14, second edition, 1985, prepared by CISPR Subcommittee F: Interference from Motors, Household Appliances, Lighting Apparatus and the Like, ($73.00) — it is a revision of a 1975 standard and its 1980 amendment....The IEC has compiled all of its basic safety standards into the 526-page *IEC Safety Handbook* ($52.00). All three documents are available from ANSI's International Sales Dept., 1430 Broadway, New York, NY 10018; add seven percent to the total cost for postage and handling.

Surge Arresters... The ANS Committee C62 has published two new standards: *ANSI/IEEE C62.1-1984: Surge Arresters for AC Power Circuits* ($7.50) and *ANSI/IEEE C62.31-1984: IEEE Standard Test Specifications for Gas Tube Protective Devices* ($6.50). They are available from ANSI's Sales Office, 1430 Broadway, New York, NY 10018.

VDTs

WHO Statement... The World Health Organization's (WHO) working group on video display terminal (VDT) health and safety has concluded that VDT radiation emissions are not hazardous. In a brief provisional statement issued following a meeting in Geneva, Switzerland, December 2-6, the eight-member panel also downplayed reproductive risks but recommended further research on rashes and other skin disorders reported by VDT users. "The cause(s) of these skin disorders is not clear," the panel said. Chaired by Dr. Steven Sauter of NIOSH, the panel plans to meet again to discuss additional topics, but no date has been set.

CORRECTIONS

Clear GAO Report... In our November/December 1985 issue, we cited an incorrect title for the review draft of the General Accounting Office's (GAO) report on the 1983 Alaskan radar accident. The July 1985 draft was titled *Further Actions Needed Following Exposure of Employees to Radiofrequency Radiation at Clear Air Force Station, Alaska....***NAS-NRC Advisory Committee...** In the same issue, we listed the membership of a National Academy of Sciences-National Research Council (NAS-NRC) advisory committee on non-ionizing radiation bioeffects. Dr. Sean McGlynn of Louisiana State University resigned just before the October 29 meeting and was replaced by Dr. Michael Kasha, the director of the Institute of Molecular Biophysics at Florida State University in Tallahassee. Dr. Stephen Brown, the staff director of the NAS-NRC Board on Radiation Effects Research, reports that Dr. Marvin Schneiderman, an epidemiologist with the Department of Preventive Medicine and Biometrics at the Uniformed Services University of the Health Sciences in Bethesda, MD, was also added to the committee.

Delgado-Leal Verification

(continued from p.1)

The attention being placed on the project reflects the need to put bioelectromagnetics research on firmer ground. The field has largely failed to attract supporters in the mainstream of the scientific community, and much of its funding either has been cut or is in jeopardy.

"There are a lot of effects that come and go and right now there is a credibility problem," Marron told *Microwave News*. "We must carefully document effects and establish their credibility among scientific colleagues in other disciplines."

The Study Plan

This spring, if all goes as planned, researchers in five labs (see box) will start their experiments using identical equipment and following the same, carefully detailed protocol. The exposure systems, which are being designed and built by Richard Tell of the Environmental Protection Agency (EPA) in Las Vegas, NV, under a contract from ONR, will use Helmholtz coils to generate PEMFs because they can provide clean and well-defined fields. The systems will also be able to record temperature, humidity and mechanical vibrations continuously.

According to Lars-Erik Paulsson of the National Institute of Radiation Protection in Stockholm, Sweden, three of the four magnetic field pulses used by Leal were noisy. (They were generated using a Grass simulator.) Paulsson visited the Madrid lab and measured 12 kHz modulation patterns on the pulses. He reported this finding at a workshop held at the Bioelectromagnetics Society (BEMS) meeting last summer in San Francisco, CA.

Leal herself will use one of Tell's exposure systems. If she fails to observe an effect, she will attempt to uncover the difference between her original setup and Tell's new one. In addition, Tell will keep one exposure system in Las Vegas and may try the experiment at the EPA lab.

"We are making a great effort to make sure that everybody is working with precisely the same setup," Rozzell said. "All they have to do is unpack the equipment, add fresh eggs and test the equipment."

The sources and types of eggs have presented some thorny problems, however. "The eggs are the weakest link," Rozzell said. One of the questions posed by the Delgado-Leal experiments is whether the high rate of spontaneous abnormalities among their control eggs was due to the source of the eggs or to some unexplained factor in the lab. All the researchers will use white leghorn chicken eggs; a supplier of fresh eggs has been identified near each of the labs.

Each run of the "basic" experiment will only take a week, and the project members should soon know whether they are getting consistent results, though they will need many runs to be sure of their findings.

Controlling the Variables

"The objective of the project is to control the things you can and describe those you can't," Marron explained at the BEMS workshop.

Study Participants

Dr. William Koch, University of North Carolina, Chapel Hill, NC. Collaborating with Dr. Ezra Berman of the Environmental Protection Agency, Research Triangle Park, NC, and William Joines of the Department of Electrical Engineering, Duke University, Durham, NC.

Dr. Jocelyne Leal, Departamento de Investigacion, Centro Ramon y Cajal, Madrid, Spain. Collaborating with Dr. Alejandro Ubeda also of Centro Ramon y Cajal.

Dr. Alexander Martin, Department of Anatomy, University of Western Ontario, London, Ont., Canada.

Dr. Kjell Hansson-Mild, National Board of Occupational Safety and Health (NBOSH), Umea, Sweden. Collaborating with NBOSH's Monica Sandstrom.

Drs. Jack Monahan and Arnold Fowler, Molecular Biology Branch, Center for Devices and Radiological Health, Food and Drug Administration, Rockville, MD.

Dr. Stephen Smith, Department of Anatomy, University of Kentucky, Lexington, KY (consultant).

Richard Tell, Office of Radiation Programs, Environmental Protection Agency (EPA), Las Vegas, NV.

Tell will visit each of the labs to characterize and measure the background fields in order to answer questions raised by some observers who believe that Leal's lab may have contained spurious radiation which harmed the development of the eggs.

Unpublished experiments by Leal indicate that the orientation of the chick embryo relative to the Earth's magnetic field and the applied field is a key variable: the teratological effect only appears in certain precise orientations. This finding confirms other results, such as those of EPA's Dr. Carl Blackman on the efflux of calcium from brain tissue (see *MWN*, September 1984). The project will attempt to investigate the role of the Earth's field, according to Rozzell.

Because ambient temperature can affect embryo development, the study protocol asks the researchers to run their experiments only between April and early June and between September and October. "We are limiting the experiments to a narrow time window to make sure the eggs are neither too hot nor too cold," explained Rozzell.

The researchers are also watching for any differences caused by the fact that the European electrical distribution system operates at 50 Hz, in contrast to the 60 Hz U.S. system.

Corporate Interest

Researchers from AT&T Bell Labs, GE and IBM attended the BEMS workshop and expressed interest in the project.

Rumors circulated at the meeting that IBM was gearing up to attempt a replication of the Delgado-Leal experiment on its own. At the time, IBM's Dr. Daniel Weinberg re-

fused to comment on the company's plans, saying only that he was at the meeting to educate himself.

In response to a request for comment from *Microwave News*, IBM spokesman Thomas Mattia said that the company has "strong reservations concerning the reliability of the Delgado findings," noting that egg studies have little or no relevance to mammalian reproductive systems and that there are "major and significant differences between the frequencies and wave shapes used by Delgado's apparatus and those generated by VDTs."

Mattia added that IBM plans to follow the ONR project and is "continuing to assess research opportunities in areas where we believe we can make meaningful scientific contributions related to our products."

Delgado Has Retired

In the summer of 1985, Delgado retired as the director of research at the bioelectromagnetic lab at Centro Ramon y Cajal. He has been replaced by Dr. F. Rubia.

CONFERENCES

1986 Conference Calendar: Addenda

The following items are additions to the 1986 conference calendar we published in our last issue:

May 5-7: **7th Annual Meeting of the Canadian Radiation Protection Association,** Quebec City, Canada. Contact: Roch Desrochers, Commission de la Sante et de la Securite du Travail, 1199, rue De Bleury, 9eme Etage, Montreal, Quebec, H3B 3J1, Canada.

May 13-15: **2nd Annual Meeting of the Electromagnetic Energy Policy Alliance (EEPA),** Ramada Renaissance Hotel, Washington, DC. Contact: Richard Ekfelt, EEPA, 1255 23rd St., NW, Washington, DC 20037, (202) 452-1070.

July 20-25: **Summer Meeting of the IEEE Power Engineering Society (PES),** Mexico City, Mexico. Contact: IEEE Society Special Services, IEEE, 345 East 47th St., New York, NY 10017, (212) 705-7893.

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, UK.

September 15-19: **23rd Congress Ampere on Magnetic Resonance,** University of Rome, Italy. Contact: Dr. F. De Luca, Secretary, 23rd Congress Ampere, Dept. of Physics, Universita di Roma "La Sapienza," Piazzale Aldo Moro 5, 00185 Roma, Italy, (6) 4976472.

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 29-October 3: **Montech'86: IEEE Week in Montreal,** Convention Center, Montreal, 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.

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

November 17-21: **31st Annual Conference on Magnetism and Magnetic Materials,** Hyatt Regency Hotel, Baltimore, MD. Contact: Dr. John Scott, American Institute of Physics, 335 East 45th St., New York, NY 10017.

Upcoming Meetings

March 5-7: **Workshop on Measurement of Electrical Quantities in Pulse Power Systems II,** National Bureau of Standards (NBS), Gaithersburg, MD. Contact: Ron McKnight, B344 Metrology Bldg., NBS, Gaithersburg, MD 20899, (301) 921-3121.

March 12-13: **IEEE 1986 National Radar Conference,** Los Angeles, CA. Contact: Radar Systems Group, Hughes Aircraft Co., R-1, D-428, PO Box 92426, Los Angeles, CA 90009.

March 12-15: **Joint Meeting of the European Workshop on Nuclear Magnetic Resonance and the World Health Organization,** Monte Carlo, Monaco. Contact: Dr. Robert Muller, University of Mons, Faculty of Medicine, B7000 Mons, Belgium.

March 25-27: **IEEE IMTC/86: Instrumentation/Measurement Technology Conference,** University of Colorado, Boulder, CO. Contact: Robert Myers, IMTC/86 Coordinator, 1700 Westwood Blvd., Suite 101, Los Angeles, CA 90024, (213) 475-4571.

April 2-3: **22nd Annual Meeting of the National Council on Radiation Protection and Measurements (NCRP),** Washington, DC. Contact: NCRP, Suite 1016, 7910 Woodmont Ave., Bethesda, MD 20814, (301) 657-2652.

April 2-4: **International Workshop on Physics and Engineering in Computerized Multidimensional Imaging and Processing,** University of California, Irvine, CA. Contact: Dr. O. Nalcioglu, Dept. of Radiological Sciences, University of California, Irvine, CA 92717, (714) 856-5904.

April 8-10: **1986 Test & Measurement World Expo,** Convention Center, San Jose, CA. Contact: Meg Bowen, 215 Brighton Ave., Boston, MA 02134, (617) 254-1445.

April 12-16: **21st Annual Meeting & Exhibit Program of the Association for the Advancement of Medical Instrumentation (AAMI),** Hyatt Regency, Chicago, IL. Contact: AAMI, Suite 602, 1901 N. Fort Myer Dr., Arlington, VA 22209, (703) 525-4890.

April 12-16: **64th Annual Convention of the National Association of Broadcasters (NAB),** Convention Center, Dallas, TX. Contact: NAB, 1771 N St., NW, Washington, DC 20036, (202) 429-5350.

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EPA RF/MW Options

(continued from p.1)

The four options are the same as those cited in a January 22, 1985 letter from then EPA Assistant Administrator Joseph Cannon to Federal Communications Commission (FCC) Chairman Mark Fowler (see *MWN*, January/February 1985).

EPA Blocked Since 1984

The EPA was set to propose an exposure limit of 100 uW/cm^2 in June 1984 but was barred from doing so when opposition surfaced at the agency's Office of Policy Planning and Evaluation. At the time, observers said the agency was responding to industry complaints that the proposal was too strict (see *MWN*, July/August 1984).

A sharp debate followed as industry urged the adoption of the ANSI standard. But EPA staffers were uncomfortable with the ANSI limits, as made clear in a memorandum prepared by the agency's Office of Radiation Programs (see *MWN*, September/October 1985):

> [Adopting the ANSI standard] would be unusual and precedent-setting in that the general population exposure limit would exceed the probable recommended occupational exposure limits (NIOSH's draft standards are one-half the ANSI values). This would create controversy and be inconsistent with traditional radiation protection practices.

In addition, the ANSI limits are in the process of being revised as a result of new experimental data on the hazards of low frequency fields (see *MWN*, July/August 1985). EPA's compromise was to ask for public comment on the four courses of action, rather than propose a single limit.

The EPA options were sent to the OMB for review last July. In the months that followed, their release was the subject of lengthy negotiations. Now, the OMB has agreed to withdraw its opposition if a number of minor changes are made. In addition to winning the approval of senior EPA managers, the revised options will probably have to clear OMB again, a step that could delay publication.

Under EPA's enabling authority, its RF/MW exposure limit, called a "guidance," will apply only to federal agencies. Once adopted, however, it would become a de facto national standard.

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1987 Conference Calendar (Part II)

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

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 shortsighted. 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^2. 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^2.

The researchers also report that fetuses of mice exposed to "nonthermal" fields (1 and 10 mW/cm^2) 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.

ELF NEWS

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, *Extememly 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/cm² 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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UPDATES

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."

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 insides houses approached 200 uW/cm^2, although "typical levels" were below 100 uW/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.

COMPATIBILITY & INTERFERENCE

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

(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.

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.

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.

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.

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^2 or 50 mW/cm^2 – and will overload at 50 W/cm^2. 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 ±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.

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 feeeding 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).

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.

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.

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 Radiofrequency 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., Arnold, 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, Vasiniementie 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),** Werner-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 Koln 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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March 9-13, 1987
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NEW PUBLICATION

Biological Effects of Electropollution Brain Tumors and Experimental Models

Edited by Sisir K. Dutta and Richard M. Millis

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MICRO WAVE NEWS

Vol. VIII No. 1 A Report on Non-Ionizing Radiation January/February 1988

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New Listings

California Cancer Cluster: Is RF Radiation Involved?

An abnormally high rate of childhood cancer has been documented in the small agricultural town of McFarland, in Kern County, southern California, but despite years of intense study, health officials have been unable to identify the cause of the cluster. Investigators have focused almost exclusively on chemical pollutants without success. Nor can they explain why McFarland is different from the dozens of similar farming towns spread throughout the San Joaquin valley.

A number of experts – as well as some McFarland residents – believe that a high-power Voice of America (VOA) shortwave transmitter in nearby Delano may play a role in the etiology of the cluster. The Delano VOA station, which is approximately four miles from McFarland, has transmitters with nearly two million watts in total output sending radio programs to Asia and to Latin America.

Three 250 kW transmitters broadcast southeast to Central and South America at 9 and 11 MHz for approximately four hours each day, according to Lynn Smith, the Delano station manager. McFarland is southeast of the VOA transmitter site – the Latin American signals are beamed over the town. (There are also four other 250 kW transmitters, as well as one 100 kW and two 50 kW transmitters.)

Radiation Is as Likely as Chemicals

In a report on the cluster released on January 28, the California Department of Health Services states that it could not "establish a causal link between any specific factor and development of the cancers." The state discounts the possible impact of radiofrequency (RF) radiation. "We don't think that the evidence that we looked at points at all in the direction of non-ionizing radiation as a problem," Dr. Raymond Neutra, the head of the state health department's Epidemiological Studies and Surveillance Section (ESSS) told *Microwave News*.

Others are not so sure. In a telephone interview, Dr. Ross Adey said that, "RF radiation is a significant factor that has not been taken seriously." Adey, the associate chief of staff for R&D at the VA Medical Center in Loma Linda, CA, has been following the McFarland investigation with keen interest for a number of years. "It is possible that the VOA radiation could have an effect on the people living in McFarland," he said. According to his very rough calculations, the ambient levels of RF radiation are in the microwatt per square centimeter ($\mu W/cm^2$) range in the town, and he points out that, "There are no animal or human studies related to prolonged intermittent exposures at these levels."

An electrical engineer at Ranger Communications, an electromagnetic

(continued on p.14)

HIGHLIGHTS

Should Non-Ionizing Radiation Risk Research Be Halted?

Arguing that microwave (MW) radiation is "one of the most thoroughly studied of all potential environmental hazards" and that "fundamental questions are still being raised about the very existence of hazards associated with low levels of exposure," Drs. Kenneth Foster and William Pickard argue that it is perhaps time to make "the conscious decision to leave some questions unanswered."

Foster, of the University of Pennsylvania in Philadelphia, and Pickard, of Washington University in St. Louis, MO, make their case in a commentary, "Microwaves: The Risks of Risk Research," published in the December 10, 1987 issue of *Nature*. The two professors, both engineers, cite three examples of bioeffects which were reported to occur at levels allowed under the 1982 American National Standards Institute (ANSI) standard: microwave auditory, heart rate and blood brain barrier (BBB) effects. In each case, they conclude that there is no low-level hazard.

Foster and Pickard (F&P) say that there are many other effects – "perhaps hundreds," including many associated with 50/60 Hz power line electric and magnetic fields – that remain to be studied. They sum up: "Granted, society must search for hazards of its technologies. But how to cope with the scientific noise that these studies produce? Such searches for hazards can go on too long, and guidelines for ending them must be established."

This commentary has provoked a great deal of controversy within the bioelectromagnetics community. (Foster prompted a similar dispute after he and Dr. Bill Guy published "The Microwave Problem" in the September 1986 *Scientific American* – see *MWN*, November/December 1986 and July/August 1987.) *Microwave News* polled the community for views on the commentary. Some declined the invitation; others were willing to be quoted.

Dr. Ross Adey, Veterans Administration: Had it not been published in *Nature*, F&P's paper would be better ignored. This and the previous paper in *Scientific American* breach the two essential tenets on which the scientific method has grown to credibility: The investigators shall be thoroughly informed on the state of knowledge in the field and shall present it competently and fairly; and a paper submitted for publication shall be competently peer-reviewed. *Scientific American* and *Nature* are read and accepted as authoritative by a vast worldwide audience of leaders in all fields of science. It is our individual and collective obligation to cleanse the taint of F&P's willful misrepresentation from the scientific literature no matter what it entails.

Dr. Robert Becker, Becker Biomagnetics: F&P have chosen to view the whole question of MW-induced health hazards based on only three effects. Since they find a lack of unanimity on the existence of these effects, they conclude that further risk analysis is unwarranted. They have ignored the literature on other effects of much greater significance as well as that ample body of literature indicating actual risks present in the human population. This paper has *no* relationship to risk analysis and F&P display a narrowness of vision common to mechanistic engineers: "If there is no demonstrable mechanism of action, there can be no risk." The question they address is too important to be left to such an incomplete and unscientific review, particularly one that reaches such an unwarranted and dangerous conclusion.

Dr. Martin Blank, Columbia University: Everyone has priorities in research but it is inappropriate for a scientist to call for "halting" research.

Dr. David Carpenter, New York Department of Health: What they are reacting to is the poor quality of some of the research that gets done. I agree with this. We should improve our standards. We need better quality controls in what gets funded and published. But I would take issue with cutting off research. It is always a mistake to shut off a whole field of research.

Dr. Stephen Cleary, Virginia Commonwealth University: I am surprised that it was published in a scientific journal since it appears to be completely counter to what I understand to be the principles of objective inquiry. In opposition to the views of the authors, I for one have not spent my career searching for "hazards." Considering the present level of support for this type of research, who needs guidelines to end it? If they were needed, who would write them? Considering the apparent difficulty encountered in writing safety standards, I do not anticipate guidelines to end research in my lifetime.

Dr. P. Czerski, Food and Drug Administration: I think this commentary confuses science and research directed to gain fundamental knowledge about EMF interactions and living systems and short-term applied research which arises out of political pressure. In a nutshell, the scientific and societal issues are confused in this article....They are entitled to their point of view, however historical experience (e.g., Michurin and Lysenko) shows that developing guidelines for halting socially undesirable research is a risky enterprise. Societal issues are best solved by democratic means and open discussion.

Dr. Christopher Davis, University of Maryland: F&P have been very subjectively selective about the three phenomena

they chose. The auditory effect is irrelevant to risks due to low-level MWs. The heart rate is not a mainstream experiment in bioeffects research and the BBB, while getting a lot of people excited, has not been confirmed. There are well-documented effects, especially in terms of genetic effects and calcium ion efflux.

Dr. Richard Frankel, MIT: I don't know why they left out the really interesting verifiable effect on calcium efflux, which is leading down a real scientific path.

Dr. Reba Goodman, Columbia University: Given the magnitude of the problems raised by low-level MW radiation and the potential environmental and health hazards, F&P's propositions are extremely unscientific and anti-intellectual. They suggest a moratorium because there are inconsistent findings and occasional modified conclusions. This is common to all research. Oddly enough, *Nature* has consistently failed to publish significant articles dealing with this branch of science. Instead, it has chosen to devote some of its valuable space to F&P's thesis.

Dr. Don Justesen, Veterans Administration: F&P purport to identify a scientific need to shut down unnecessary "risk" research. I'm disappointed in their commentary for several reasons. One, the tacit assumption that investigations in these areas were wholly motivated by hygienic concerns is invalid. Most scientists are driven primarily by curiosity – by a desire to establish and understand functional relations. Second, F&P's history is flawed; in my opinion, they sometimes don't "tell it like it is" – or was. And finally, F&P are guilty of finding fault without offering solutions.

Dr. Samuel Koslov, Johns Hopkins University Applied Physics Laboratory: I get the impression that the authors have not bothered to follow the field for at least five years. The defense of the 1982 ANSI standard seems rather futile in that the NCRP, Canada, Sweden and many local standards have deviated from it, often with recognition of flaws in physical reasoning. The most remarkable aspect of the article is that the advocacy position seems to be to define guidelines to end the search for hazards despite unexplained observations. This is a new line of thinking in science for me.

Dr. Jocelyne Leal, Centro 'Ramon y Cajal' (Spain): This subject of research is not very different from any other subject. In neurophysiology, for example, you can find thousands of results that could not be confirmed, others contradictory and still others due to artifacts. Such outcomes are intrinsic to any experimental research. We are working in a young science, frequently stumbling! But can we afford to deny its importance? From the moment that there is a suggestion that EMFs can affect living organisms, it must be investigated. This is the main responsibility of the scientific community and developed societies.

Dr. Granger Morgan, Carnegie-Mellon University: As you know from my *Science* editorial (*232*, p.917, May 23, 1986), I think starting and stopping rules for federally-funded risk-motivated applied research are important. I wish that F&P had drawn a sharper distinction between such programs and basic science, where the considerations are very different. In the case of risk-motivated applied research on 60 Hz, we have some good examples of such rules not operating well enough. Work on animal perception studies went on longer than needed and work on animal cancer promotion has been too slow in starting.

Dr. John Osepchuk, Raytheon Research Division: An excellent article. It points to a real problem in the field. I am sure the authors are not calling for a cessation of research except that which leads to fruitless research or to ephemeral results. Instead, I am sure they support research that leads to a permanent and reliable data base.

Dr. Richard Phillips, Environmental Protection Agency: It is a biased article. It is a disservice to the other people in the field and to F&P. I don't understand why they wrote it.

Dr. Asher Sheppard, Veterans Administration: F&P attack some straw men in setting up MW effects on hearing, heart rate and BBB as potential hazards. They then tell us these effects can be "explained" as artifacts or denigrated as the expression of contentiousness by a few. Of course, they fail to mention evidence concerning cancer, genetic effects or the altered permeability of eye tissues; nor do they credit the wealth of good research which has come out of inquiry into high- and low-level effects....I am dismayed that the readers of *Nature*, who do not know the limited scope which F&P bring to their pronouncements, will not realize their views are merely provocations from a know-nothing fringe. In a word, it's a "smear."

Dr. Maria Stuchly, Health and Welfare Canada: I have not read anything new there. They carry their assessment too far. I do not share their opinion overall.

Dr. Mays Swicord, Food and Drug Administration: As the authors suggest, the literature contains thousands of reports of RF bioeffect studies of varying quality and results. One can of course prove any point by selectively drawing from such a data base. To do so is either scientifically naive or dishonest.

Dr. Tom Tenforde, Lawrence Berkeley Laboratory: I find it discouraging that two talented scientists such as F&P should take such a dim view of research on the biological effects of microwave radiation. Their point that much confusion has been generated by research that was incomplete or poorly conducted is undoubtedly correct. However, the fact there are unresolved issues in this field argues for more research, not less!

IRPA Relaxes RF/MW Standard

The International Radiation Protection Association's International Non-Ionizing Radiation Committee (IRPA/INIRC) has relaxed some provisions of its 1984 "interim" radiofrequency and microwave (RF/MW) radiation exposure guidelines, especially with respect to low frequency exposures and peak pulsed fields.

Occupational limits are now 614 V/m and 1.6/f A/m for 100 kHz-1 MHz electric and magnetic fields, respectively, and 614/f V/m and 1.6/f A/m for 1-10 MHz (where f= frequency in MHz). There is a provision that if there are risks of RF burns, they can be eliminated "in most situations" by reducing the electric field to 194 V/m for 100 kHz-1 MHz and to $194/f^{1/2}$ V/m for 1-10 MHz.

In the 1984 standard, the two sets of limits were reversed: occupational limits for 100 kHz-1 MHz were 194 V/m and 0.51 A/m for electric and magnetic fields, respectively, and $194/f^{1/2}$ V/m and $0.51/f^{1/2}$ A/m for 1-10 MHz, with the advisory that the limits could be exceeded up to 615 V/m or 1.6 A/m, "provided workers take the necessary precautions to prevent potentially severe RF burns."

Dr. P. Czerski, of the Food and Drug Administration's Center for Devices and Radiological Health and a member of the IRPA/INIRC, told *Microwave News* that by directly addressing the low frequency risks, the limits could be loosened at low frequencies. He explained that the standard is now "more precise." He added that, "It is a loosening predicated on the additional criteria of exposure."

For the general population, the 1984 and 1988 guidelines are identical except for the magnetic field limit between 100 kHz and 1 MHz, which has now been loosened from 0.23 A/m to $0.23/f^{1/2}$ A/m.

The other major change is that the suggested peak pulsed field should not be greater than 1,000 times the six-minute average power density. The 1984 interim limits suggested that the pulsed field should not be more than 100 times greater. Czerski argued that the reduction was needed because the 1984 limit was "too strict, with no good rationale."

In a statement accompanying the new guidelines, the IRPA/INIRC notes that its guidelines are still based on a 0.4 W/Kg whole-body average specific absorption rate (WBA-SAR) because: "A close scrutiny of the available data revealed no need to revise the previously adopted basic WBA-SAR."

The guidelines specify that excessive heating of wrists and ankles can be avoided by limiting body-to-ground currents to 200 mA. The IRPA/INIRC advises that, "In general, RF burns will not occur from currents on point contact of 50 mA or less." The committee notes that a simple ammeter is "sufficient" to verify the maximum current flow.

The IRPA/INIRC considered the potential risks of cancer and congenital abnormalities and concludes that, "Available data are inconclusive and cannot be used for establishing exposure limits."

"Guidelines on Limits of Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 100 kHz to 300 GHz" appears in the January 1988 issue of *Health Physics*. The 1984 guidelines appeared in the journal's April 1984 issue (see *MWN*, March 1984). Members of the IRPA/INIRC are: H.P. Jammet, chairman, France; J. Bernhardt, Federal Republic of Germany; B.F.M. Bosnjakovic, The Netherlands; P. Czerski, U.S.A.; M. Grandolfo, Italy; D. Harder, Federal Republic of Germany; B. Knave, Sweden; J. Marshall, Great Britain; M.H. Repacholi, Australia; D.H. Sliney, U.S.A.; J.A.J. Stolwijk, U.S.A.; A.S. Duchêne, scientific secretary, France.

Radar Radiation Exposure & Unexplained Memory Loss

A pilot who was overexposed to microwave radiation experienced neurological problems long after other overt symptoms disappeared. In a letter to the *Journal of the American Medical Association* (January 15), Drs. Mauricio Castillo and Robert Quencer describe the case of an F-16 pilot who was accidentally exposed to radar radiation.

The 42-year-old civil air patrol pilot felt a moderate heat sensation after standing in front of an F-16's functioning radar system for five minutes last summer. The next morning he noticed a tender lump in his lower neck, which continued to grow and cause discomfort. Over the following month, the lump persisted and the pilot experienced a loss of short-term memory and extreme sleepiness. A doctor found a second small lump at the base of his tongue and diagnosed his condition as being caused by a thermal insult.

The patient's symptoms, which also included the inflammation of his pharynx and vocal chords, disappeared with time – except his memory loss which persisted. A magnetic resonance scan of his brain was normal, however.

This was a "disruptive event" for the patient, Dr. Castillo told *Microwave News*. "He would go shopping and would not know how to get home. He had to carry a card with his wife's telephone number to find out how to get back." But Dr. Castillo added that the patient's memory was improving when he last spoke to him in October.

Dr. Castillo, a radiologist, and Dr. Quencer, who is the head of the Magnetic Resonance Imaging Center, are both at the University of Miami School of Medicine's Jackson Memorial Hospital in Florida. (See also the special report on radiation accidents on pp.10-11.)

LLNL Guidelines for Exposures to Static Magnetic Fields

The Lawrence Livermore National Laboratory (LLNL) has adopted guidelines for exposures to static magnetic fields. The peak allowable exposure limit is 2T, and areas where

fields exceed 50 mT are limited to authorized personnel only.

Writing in the December 1987 issue of the *American Industrial Hygiene Association Journal*, LLNL's Gordon Miller reports that the time-weighted average (TWA) for the trunk is 60 mT. He explains that this guideline is based on limiting the magnetohydrodynamic (MHD) voltage to 1 mV, a level tolerated by primates without evidence of ill effects. It is a "conservative criterion," according to Miller, since it is also based on the assumption that an obese person engaged in sustained moderately heavy work and exposed to 60 mT will experience a voltage rise of 1 mV. The 2T limit is based on the patient-exposure recommendation of Dr. Tom Budinger of the Lawrence Berkeley Laboratory.

Miller cites a warning level of 1 mT for people with pacemakers or prosthetic implants. He explains the rationale thus: "1) Warning at the 0.5 mT level would have meant blocking off a major road on site; 2) no artificial pacemaker has been identified that has a reed switch that functions below 1.4 mT; and 3) the quality assurance testing of reed switches is exceptionally stringent."

Miller cautions that these static field guidelines "cannot be used as standards." He explains that, "The exposure criteria will need to be revised when the results of further research are available." He advocates continued research because of the likelihood that the introduction of superconductors will result in an increase in the number of people exposed.

Miller also reviews time-varying magnetic fields and concludes:

> It is also reasonable to suggest that setting guidelines for time-varying magnetic (and electric) fields would be imprudent until the results of animal exposure studies verify or disprove the hypothesis that time-varying fields are mutagenic, carcinogenic, or teratogenic, and the mechanisms by which such fields do harm have been demonstrated beyond reasonable doubt.

CISPR, ISM & Barriers to Trade

The International Special Committee on Radio Interference (CISPR) has called for "urgent action" to review its radiation emission limits for industrial, scientific and medical (ISM) equipment.

In its latest publication (CISPR 23), the committee notes that, "It is evident that equipment which is incapable of being made to meet CISPR limits is being used in practically every country in the world," but also that, "the number of interference complaints which are traceable to ISM equipment is very low compared with that from other sources." In other words, the current standards are not being met, but it does not seem to make a difference in terms of observable electromagnetic interference (EMI).

CISPR calls the present situation "unsatisfactory" and worries that its limits are overly strict and are being used as technical barriers to trade on an ad hoc basis.

Liliane Volcy of the Federal Communications Commission (FCC), who has been monitoring CISPR ISM developments, told *Microwave News* that past attempts to revise the CISPR ISM limits have failed and that the prospects for the future also look dim. The U.S. has voted against the revisions because they are too vague and because the specifications can be misrepresented and may lead to potential abuse in their application. Volcy explained that, "It is a myth that the U.S. standards are weaker that those of CISPR. They are specified differently and cannot be readily compared."

Volcy said that there have been cases of CISPR standards being used to prevent the export of U.S. equipment – notably, medical and welding equipment. When asked if the U.S. has retaliated to control imports, she said that this has not happened, though "the growing protection mood in the U.S. might force some type of retaliation."

Copies of *Determination of Limits for Industrial, Scientific and Medical Equipment* (CISPR 23) are available for $36.00 each (prepaid), including postage and handling, from: American National Standards Institute, International Sales Department, 1430 Broadway, New York, NY 10018, (212) 642-4900.

CONFERENCES

New Listings

March 8-9: **First International Conference on Formulating Food for the Microwave Oven,** Drake Hotel, Chicago, IL. Contact: The Packing Group Inc., PO Box 345, Milltown, NJ 08850, (201) 636-0885.

June 20-22: **18th Power Modulator Symposium,** Hyatt Hotel, Hilton Head Island, SC. Contact: Leslie Gallo, Palisades Institute for Research, 2011 Crystal Dr., Suite 307, Arlington, VA 22202, (703) 769-5580.

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

August 10-12: **Symposium on Antenna Technology and Applied Electromagnetics,** University of Manitoba, Winnipeg, Canada. Contact: Professor L. Shafai, Dept. of Electrical Engineering, University of Manitoba, Winnipeg, Manitoba, R3T 2N2, Canada, (204) 474-9615.

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

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

March 7-9, 1989: **8th International Symposium and Technical Exhibition on Electromagnetic Compatibility,** Zurich, Switzerland. Contact: Dr. T. Dvorak, ETH-Zentrum-IKT, CH-8092 Zurich, Switzerland, (1) 256-2790.

May 9-12, 1989: **Dresden Symposium on Electrostimulation,** Dresden, G.D.R. Contact: Dr. K.-J. Schulze, Medical Academy "Carl Gustav Carus," Dept. of Orthopedics, Fetscherstrasse 74, Dresden, 8019 G.D.R.

(The entire 1988 conference calendar appeared in our last issue.)

Brain Tumor Victim Sues HL&P

A Texas family whose land had been condemned for a power line right-of-way (ROW) by Houston Lighting & Power (HL&P) has sued the utility, alleging that the electromagnetic fields (EMFs) from the line caused one of them to develop a brain tumor.

HL&P bought an easement of more than half an acre from Beverly Scott Rainwater for $11,000 in 1980; there are three buildings on the remainder of the lot. Rainwater works in a house within 20 feet of the 345 kV power line. Her brother, Michael Scott, and his wife, Vicki, live in a house which is approximately 150 feet from the line. Their mother lives further away on the lot. HL&P energized the power line in 1983. In 1987, Michael Scott, then 26, developed an astrocytic brain tumor.

The 345 kV line first became the center of controversy when the Klein Independent School District sued HL&P for placing it across school property without proper permission. In 1985 a jury awarded the school district $25 million in punitive damages (see *MWN*, November/December 1985). Late last year, an appeals court reversed the award but affirmed the potential health issue – by that time, HL&P had moved the line at a cost of $8.6 million (see *MWN*, November/December 1987). The decision is being appealed.

In two suits filed on December 14, John McDowell, the attorney representing the family, charged that HL&P should have warned his clients about EMF health risks and also should have moved the line to reduce the family's exposure to EMFs, as it had done in the case of the Klein school. McDowell alleged that HL&P was negligent in its failure to warn the family, which was "inexcusable and reprehensible conduct." In addition, he argued that HL&P committed fraud by not disclosing – in the course of the original real estate transaction – the health risks.

In a telephone interview with *Microwave News*, McDowell said that documents released in the Klein case revealed that HL&P started collecting material on the health effects of power line EMFs in 1975, but had not made this information public. "Under Texas law," he said, "if you find out about a health risk, you have a duty to warn people about it."

In papers filed with the court on January 11, HL&P denied the allegations.

McDowell said that he does not expect the case to go to trial for at least 12 to 18 months.

BBC To Cover Power Lines

The British Broadcasting Company (BBC) is in the process of taping an hour-long documentary on the health effects of power line electromagnetic fields.

The documentary will be aired on the BBC's *Panorama* program – roughly the equivalent of the U.S.'s *MacNeil/Lehrer Report*. Tom Mangold, the show's correspondent, told *Microwave News* that the program will be broadcast on March 21. Paul Gibbs is the producer. It is not yet clear whether the documentary will be shown on American television.

EPRI Developments

Dr. Richard Balzhiser has been appointed the new president and chief executive officer of the Electric Power Research Institute (EPRI). Balzhiser has been with EPRI since 1973, most recently as executive vice president. Previously, he was the chairman of the department of chemical engineering at the University of Michigan in Ann Arbor.

Risk Analysis & Measurements

EPRI's electric and magnetic fields (EMFs) group is in the process of reviewing proposals for two new projects on risk analysis and on measurements:

- *Risk Management Frameworks:* The winning bidder on project No.RP2560-1 will assess the potential value of formal risk management methods in addressing EMF concerns and, where appropriate, will develop such frameworks. Proposals were due on December 4.
- *Measurement Project for Utilities:* The contractor for project No.RP2966-1 will organize and run workshops to train utility staffers in the collection and interpretation of EMF measurement data collected with the recently-developed EMDEX system. Proposals were due on December 15.

Revised Edition of the "Red Book"

EPRI has issued a revised version of the second edition of its *Transmission Line Reference Book: 345 kV and Above* (EL-2500), commonly known as the "red book." The 625-page volume features 13 chapters, written by a variety of experts and covering all aspects of high voltage power lines, including EMF effects, corona loss and radio and audio noise. The EMF effects chapter was written by Dr. Don Deno and L.E. Zaffanella, both of General Electric Co. A copy of the red book is available for $110.00 ($220.00 outside the U.S.) from: Research Reports Center, PO Box 50490, Palo Alto, CA 94303, (415) 965-4081.

Congressional Hearings Video

EPRI has prepared a 52-minute videotape of excerpts from the three-and-a-half-hour congressional subcommittee on water and power resources hearings held on October 6 (see *MWN*, September/October and November/December 1987). The tape is available in VHS, Beta and 3/4-inch formats for $50.00; order code: EA87-15. Contact: Susan Rapone, EPRI, PO Box 10412, Palo Alto, CA 94303.

Workplace ELF Exposures

A group led by Dr. Joseph Bowman of the University of Southern California (USC) School of Medicine in Los Angeles will soon publish measurement data indicating that "electrical workers" are exposed to extremely low frequency (ELF) magnetic fields that are "significantly above the levels encountered in residences and most offices."

In a paper which will appear in the May 1988 issue of *Applied Industrial Hygiene*, Bowman and coworkers conclude that these elevated workplace exposures lend support to the hypotheses generated by occupational leukemia studies. Many of these studies have found that electrical workers are at a greater risk of developing cancer (see, for example, *MWN*, March/April and May/June 1986). Very little information on the actual exposures of electrical workers has been available, however.

Among those exposed to the highest magnetic fields were: electricians working with industrial power supplies; underground and overhead power line workers; welders; and transmission station and distribution substation operators. The exposures varied considerably – some were above 100 mG, though most were between 10 and 50 mG. In comparison, residential exposures were normally below 1 mG.

The USC team found that elevated magnetic field exposures are not limited to the "electrical worker" job categories, but can also occur near such devices as battery-driven forklifts.

The difference between electric field exposures in workplaces and in residences tended to be lower than in magnetic fields due to the effective shielding provided by metallic electrical equipment.

In an interview with *Microwave News*, Bowman cautioned that his exposure estimates are preliminary and should be considered in the context of a "pilot" study. Bowman was recently awarded a contract by the Electric Power Research Institute (EPRI) to carry out more detailed occupational measurements – that study is just getting started (see *MWN*, July/August 1987).

Wertheimer and Leeper on Epi Study Pitfalls

Reprinted below is a memorandum from Dr. Nancy Wertheimer and Ed Leeper on "Possible Pitfalls in Interpretation of ELF Research." The memo is dated November 4, 1987.

Many "heresies" of our 1979 paper have now become almost commonplace: There is, today, fairly good acceptance for the importance of magnetic (not just electric) fields (MFs), and for the possibility that physiological effects may occur with milligauss fields; for the role played by ground-return currents in putting MFs out into the environment; for the validity of wiring configurations as an index of MF exposure; and for the relatively modest exposure from most appliance sources (as opposed to the 1979 consensus that the "25 gauss hairdryer" precluded any possibility of an effect from milligauss fields) – and so forth.

We feel our track record has been a decent one. And we hope that, on the strength of it, our further ideas on the subject will be seriously considered. Those ideas include the following:

1. *Little increase in cancer is to be expected among young children exposed prenatally to the most extreme sources* of chronic MF exposure. We have seen this pattern in our own data and in that of Fulton, Myers, Tomenius and Savitz. Moderate exposures before birth were, in each case, associated with increased cancer after birth; but extreme exposures, encountered prenatally, were not. Our hypothesis is that this pattern occurs because MFs can have an adverse effect on tissue development which, if it is severe and occurs in the first trimester of pregnancy, may often lead to prenatal abortion rather than to postnatal cancer.

2. *Little increase in cancer is to be expected in subjects who once lived at high-exposure homes, but who left those homes* more than two or three years prior to cancer diagnosis. (See Table 7 of our adult cancer paper, and the discussion of "onset age" in our 1979 paper. Note also that the Savitz study deals almost entirely with addresses occupied within three years preceding diagnosis.) And presumably a similar pattern may hold for occupational exposures.

3. *An increase in cancer rate may not be seen at all ages for a given type of cancer*. A discussion of this possibility is presented in some detail in our recently published paper, "Magnetic Fields and Cancer Subtypes" (*Annals of the New York Academy of Sciences, 502*, pp.43-54, 1987).

We have written this memo to urge those involved in epidemiological work on MF effects to try to explore the above ideas in their project planning and in their interpretation of results. Not all the ideas may prove valid, but there is a reasonable amount of evidence for them in existing data. And if they *are* valid, then not to include them in evaluating studies could lead to false negative conclusions, since each idea delineates an area where increased cancer risk may *not* occur with increased MF exposure, even if the hypothesis that MFs affect cancer proves to be true generally.

Congressional Questions on ELF Research

Following the October 6 hearing on the health effects of the extremely low frequency (ELF) electromagnetic fields (EMFs) associated with power lines, Congressman George Miller (D-CA), the chairman of the House subcommittee on water and power resources, asked the witnesses to follow up their testimony by supplying written answers to a number of detailed questions. Reprinted below are excerpts from some of those questions and answers. The complete exchanges will be published in the official hearing record, which is now at the printer and should be available in a couple of months. (See also MWN, *September/October and November/December 1987.)*

Dr. Ross Adey, VA Hospital, Loma Linda, CA

Q: When will the NCRP report on ELF to EPA come out?
A: We anticipate completion of the final draft in the spring of 1988. However, in accordance with NCRP procedures, review of this draft by the governing board is likely to take another year before publication.
Q: Please describe how the Department of Health and Human Services (HHS), in particular the NIEHS, has been involved in research on the biological effects of transmission lines. Have you ever tried to get funds from NIEHS or NIH?
A: I am not aware that any agency of HHS has ever been involved in significant support of any studies of possible health effects of power lines, either through support of individual projects or on a programmatic basis.

NIEHS has had a small program of intramural and extramural research, but this has dwindled in the last three years to an insignificant effort. The focus of intramural research at NIEHS was on reproductive abnormalities resulting from microwave exposure of birds' eggs. These studies were terminated two years ago and the laboratory closed. Studies of health effects of non-ionizing electromagnetic radiation (NIR) have held a low priority at NIEHS since their inception about 15 years ago, placing far greater emphasis on toxicology of environmental chemical pollutants. However, *NIEHS management has never considered the potential importance of joint actions of EM fields and chemical pollutants in cancer promotion and other health hazards....*

It has been the NIH custom to refer research proposals on NIR to radiology study sections with memberships composed almost exclusively of ionizing radiation biophysicists and physicians. In consequence, I and others are frequently requested to act as external reviewers on these proposals on an *ad hoc* basis. There is the presumption in this policy that there is no need for a separate study section to represent the constituency of researchers in NIR, or worse, that ionizing radiation scientists are inherently competent to examine these proposals. I submit that this is perilously close to malfeasance in public office. In essence, *we have grown contemptuous and frustrated by NIH policies to the point where it is recognized that no good purpose is served by submitting research proposals to NIH.*

The NCI sent a representative to several scientific meetings and symposia on bioelectromagnetics in 1985 and 1986. Personal discussions with him failed to elicit any indication that he grasped the significance of either the physics or the biology of these presentations. His own area of professional competence is restricted to ionizing radiation. It would not seem realistic to expect that his reports to NCI management would reflect a pervasive awareness of the scope and content of current knowledge.

Dr. Robert Becker, Becker Biomagnetics

Q: To do research adequately, a researcher needs upfront funding to finance research for approximately how many years?
A: The minimum number of years for which funding must be assured is three to four years....If the regulatory agencies or other branches of the federal government require that the mechanism of action of such fields upon the human be determined before any action is taken, much valuable time, as well as lives, will be lost. Speaking as a physician I believe that such information is not required to deal with this urgent health problem. I therefore recommend that two approaches be taken concurrently. One, that laboratory evidence linking such exposure to cancer and genetic abnormalities be expedited. ...Two, to link such fields with human diseases in the real world, large-scale epidemiological studies need to be performed. It is via this approach that one will be able to determine the actual level of such fields that is productive of harm....I further suggest that such studies be undertaken at the two ends of the electromagnetic spectrum currently in use, that is, at the 60 Hz power frequency and at microwave frequencies.
Q: Do you think that chronic exposure to ELF fields has an effect on progeny and birth weights?
A: I believe that the data obtained in my laboratory and published in 1975-76 indicated that chronic exposure to ELF fields results in decreased birth weight and survivability of progeny....I further believe that the extensive studies done at Battelle and funded by the DOE are supportive of my results....

Sheldon Meyers, EPA

Q: How was the public policy decision to cut out all funding for NIR made at EPA?
A: The purpose of the NIR research program at EPA was to provide scientifically credible data on health effects to support guidance to other federal agencies on matters regarding NIR. The agency's Science Advisory Board reviewed a report on the biological consequences of radiofrequency (RF) radiation completed in 1984, and concluded that the report provided a scientifically defensible basis for developing guidance for RF radiation. The agency then considered expanding its research program on the health effects of ELF radiation. However, when ELF was considered next to other emerging priorities, such as radon, indoor air, stratospheric ozone, and global warming, it was ultimately decided the NIR research program would have to be phased out in order to increase our activities in these other important areas.

Dr. Jerry Phillips, Cancer Therapy & Research Foundation

Q: How would you describe the current state of funding for ELF NIR studies?
A: A number of adjectives come to mind when asked to "describe the current state of funding for ELF NIR studies," including, but not limited to, pathetic, abominable, and disgraceful. Dr. Ross Adey and others, testifying at the October hearing, have already painted a dismal picture in which frustrated scientists must confront a decrease in DOE's ELF budget, near extinction of ONR's budget, and no appropriate programs at either NSF or NIH. It appears that the electric utility industry is now funding more ELF work than any federal agency, a situation which, because of that industry's proprietary interest in such research, should, if nothing else, cause the government to fund well-planned and well-directed ELF research at a level at least comparable to industry's. Furthermore, while the U.S. is generally a leader in world science, one now sees us taking a definite back seat in government commitment and funding to the much smaller country of Sweden in the area of NIR research....I and several of my colleagues have encountered reluctance on the part of those charged with reviewing NIH and NSF grant proposals to recommend funding research in the area of bioelectromagnetics....I would recommend committing to a ten-year ELF research program. Individual researchers applying for ELF program funds should, as is

done commonly now, submit proposals detailing three to five years of scientific study, recognizing that funded projects would be eligible for renewal as is done at the NIH or NSF.

Dr. Richard Phillips, EPA

Q: What would be an appropriate level of funding for the federal government and non-federal organizations to spend during the next five years to adequately research the health effects of non-ionizing radiation?

A: ...It is my opinion that it would require about $7-8 million a year for five years to adequately research the health effects of ELF radiation.

Q: Earlier this year, I understand you attended the electromagnetics meeting in Portland. How would you assess what was reported at the meeting? Do you think that non-ionizing radiation presents a serious health risk?

A: ...The results have shown the following: 1) There is an association between the incidence of cancer in humans and exposure to 60/50 Hz magnetic fields. 2) A number of mortality studies in the U. S. and in Europe have shown that the incidence of cancer is elevated above the general population level among workers in electrical and electronic occupations. Such workers are likely to encounter exposures to electric and magnetic fields at power frequencies, i.e. 60/50 Hz. 3) Exposure of laboratory animals to 60 Hz electric fields causes a phase delay in the circadian rhythm (daily biological rhythm) and a marked reduction in the normal nighttime increase in the level of melatonin, a hormone produced by the pineal gland located in the brain.... 4) Exposure to ELF radiation during a certain period of the circadian rhythm of laboratory animals reduces the effectiveness of drugs to relieve pain. 5) An increased incidence of fetal malformations has been reported in swine, rats, mice, chickens and humans exposed to ELF radiation. 6) Exposure of human cancer cells in vitro to 60 Hz EMFs increases their rate of growth. 7) Exposure of brain cells in vitro increases the efflux of calcium ions from brain cells at specific frequencies and amplitudes. 8) Exposure of cells in vitro activates protein production by DNA and may alter gene expression. The observed effects are frequency specific. 9) Exposure of cells in vitro activates the production of ornithine decarboxylase, an enzyme that may be important in cancer promotion.

...I have to conclude that exposure to ELF radiation can produce adverse biological effects. However, before one can state with any degree of confidence whether or not exposure is harmful to humans, and at what level and with what duration of exposure, we need to verify the effects that have been reported, quantify them in terms of exposure level and duration of exposure, and establish a basis for extrapolation of this data from animal studies and in vitro studies to the situation for humans....

Q: On September 16, 1986, you spoke in Toronto at a utility symposium on the health effects of EMFs. At that time, you said you wouldn't buy a home along a power line right-of-way (ROW). Do you still feel this way?

A: Yes. The reason for my answer at the Toronto meeting was based primarily on economics....If a causal relationship is established between exposure to magnetic fields and cancer, homes adjacent to ROWs of 230 kV or higher high-voltage power lines are very likely to show a marked depreciation in value. Accordingly, I would not buy a home on the edge of a ROW of a high-voltage power line. My answer to this question is still yes, not only for the economic concern I had at the time of the Toronto meeting, but because additional information that has come from more recent research indicates there may truly be a health hazard associated with chronic exposure to ELF radiation.

Robert Rabben, DOE

Q: [In a] memo provided by the Office of Energy Storage and Distribution to the subcommittee, it says, "In DOE's view, investigation of the potential for health hazards due to EMFs is in the public interest. While research has shown that there are probably few direct short-term effects, the possibility of cancer enhancement cannot, at this point, be totally excluded." In view of the above statement, why did DOE expect a decrease in funding for FY 1988?

A: We believe that sufficient funds were requested to continue examining the most important health issues.

Dr. Leonard Sagan, EPRI

Q: What sort of clearance process does a researcher receiving funds from EPRI have to go through before the researcher's results are published? Do EPRI-supported researchers have to agree to restraints on what they find?

A: Results of EPRI-funded work may be published as either EPRI reports or in the open scientific literature. Studies published as EPRI reports are edited by EPRI staff members for both readability as well as for scientific accuracy. There are no restraints on what EPRI-funded researchers may publish in the open literature. Our standard contract does request that a copy of manuscripts be provided us at least one month before submission. Normally the EPRI project manager would [review] a manuscript with the investigator and suggest changes if warranted. They are not mandatory, however.

Q: In 1979, Dr. Nancy Wertheimer found results which some considered startling. Why didn't EPRI agree to fund a repeat of the Wertheimer study to confirm or deny her findings?

A: EPRI was not asked to fund a repeat of the Wertheimer study. We chose not to take an initiative to repeat this work because the New York Power Lines Project undertook a replication, the results of which are now available. EPRI has initiated a study of childhood leukemia and its possible relation to EMFs in another city, Los Angeles. Still another study is now in our planning process.

Dr. David Savitz, University of North Carolina

Q: If there were no limits on funding, what studies would you recommend be supported?

A: The electric utility worker study that we are conducting and a similar study conducted by investigators in Canada and France constitute one important strategy for expanding knowledge of the effects of occupational exposure. More work might be done, but these studies seem sufficient in that realm.

The area which is being developed more slowly and is in great need of government funding is the study of residential EMF exposures and childhood cancers. If funding were available, the next study of this issue should: 1) Cover a geographic area (probably three to five large urban populations) of sufficient size to study newly diagnosed cases of leukemia, brain cancer, and possibly lymphomas, along with controls identified around the time of case diagnosis; 2) Use a coordinated exposure assessment protocol based on wiring and in-home measurements. This is not radically different from our study or the ongoing Los Angeles study, but the study size would be notably advantageous, and by fine-tuning the methods based on past experience, a superior study would result.

It might also be noted that studies of this type are very difficult for independent investigators to develop because of their expense and logistical complexity. I would estimate that this study would cost at least $2-3 million. The NCI has a tradition of noting suggestive findings and embarking on the most definitive study possible to confirm or refute those suggestions. An excellent example is the national bladder cancer study designed to address concerns with artificial sweeteners. I participated in a multi-center study of invasive cervical cancer with similar goals of addressing suggestive literature with more definitive information. Thus, I would be most supportive of the NCI developing (ideally with the collaboration of outside investigators) such a multi-center study of residential magnetic field exposures from power lines and childhood leukemia, cancer and lymphoma.

U.S.A.F. Investigations of Radiation Incidents

At least ten times from June 1984 to June 1986, the U.S. Air Force (USAF) has investigated actual or possible overexposures of personnel to radiofrequency (RF) radiation. According to documents obtained by *Microwave News* under the Freedom of Information Act, officials at the Occupational and Environmental Health Laboratory (OEHL) at Brooks Air Force Base (AFB), TX, have confirmed partial or whole-body exposures above the USAF's permissible exposure limits (PEL) in five of the incidents. The USAF's frequency-dependent PEL is keyed to a specific absorption rate (SAR) of 0.4 W/Kg over a six-minute period.

The following summaries of the ten incidents are based on OEHL's reports. Copies may be obtained from: OEHL, Aerospace Medical Division, Brooks AFB, TX 78235. Refer to the report numbers that appear at the end of the summaries.

• On September 14, 1983, six workers were exposed to 420 MHz fields possibly as strong as 390 mW/cm² at Clear USAF Station, AK, when a technician accidentally switched on a high-power AN/FPS-92 tracking radar while the men were performing maintenance work (see *MWN*, November 1983, January/February and December 1984 and November/December 1985). OEHL conducted an RF radiation hazard survey at Clear on April 28, 1985, at the request of FELEC Services, Inc., the USAF's contractor for the facility. Though the survey report included no data that pertains directly to the accident, it concluded that the AN/FPS-92 radar "cannot be operated when personnel are in the radome," where the men had been working. The OEHL survey measured a maximum field of 3 mW/cm² from the AN/FPS-92 on the rooftop of a building 700 feet from the transmitter. Fields atop the roofs of scanner buildings located in front of AN/FPS-50 Detector Radars ranged from 5 to 30 mW/cm², and the USAF concluded that personnel should be prohibited from entering these areas during radar operation.
(Report No.85-105RN998FRA)

• On June 12, 1984, while installing an antenna on top of a TRC-87B radio van in 90-degree weather, an air national guardsman with the 103rd Tactical Control Squadron in Orange, CT, reported feeling hot. At one point the airman, Donald Wilson, inadvertently bumped against a support at the base of the antenna, which he said "felt like he had touched a hot car seat," and he immediately withdrew his arm. OEHL investigators later estimated that the contact lasted no longer than two seconds. Wilson's supervisor noticed the airman was sweating and told him to come down. The entire incident lasted 10-15 minutes, according to the investigators, who recreated it on February 4, 1985. They could not determine whether the system was transmitting during the incident, but the TRC-87B antenna, which runs at 259.4 MHz, was set to operate at 10 watts. The doctor who examined Wilson immediately after the incident observed a "mild" second-degree burn on part of one arm and first-degree burns on both arms. He "presumed" that the more severe burn resulted from RF exposure, according to the OEHL report. Two days later, Wilson reported nausea, diarrhea and cold, clammy skin after working outdoors. Officials supervising the recreation concluded that the airman "definitely was not overexposed" to RF radiation and that his second-degree burn was sunburn, aggravated by contact with the hot metal antenna support. Wilson may have been exposed to approximately 90 mW-s/cm² at his head, hands and torso and to approximately 1 mW-s/cm² at his upper arm, where the second-degree burn occurred. The PEL for the system's frequency is 2.59 mW/cm². Wilson's other symptoms were diagnosed as heat exhaustion.
(Report No.85-066RN491CRA)

• On September 1, 1984, two radio technicians for the Air National Guard in Savannah, GA, were attempting to fix a power amplifier problem inside a 775 MHz electrical equipment shelter (equipped with an MRC-113(V)2 open waveguide 283 CCS ANG) when they noticed that a waveguide collar connector and clamps had not been secured in a previous maintenance adjustment. In a test, the workers measured what they thought was a significant level of RF leakage into the shelter. That evening, TSgt. Ian Carson, who had been working near the shelter door, felt tingling in his hands, and as of February 1985, the date of OEHL's report, he continued to suffer intermittently from hand- and finger-joint pain. Investigators who reconstructed the event in December 1984 concluded that the worker was exposed to a maximum of 57 and 90 mW/cm² in his left and right hand-wrist areas, respectively. While finding that Carson had been overexposed – the applicable PEL is 7.75 mW/cm² – the OEHL report offered no clear explanation for his ailment, but concluded that induced current was not the cause. The second worker did not report adverse effects, and the USAF concluded that he had not been overexposed. Although not noted in the text of the report, Carson complained (in an attached statement) of suffering from previously non-existent high blood pressure. The USAF recommended further medical evaluation and suggested that technicians conduct RF radiation surveys of waveguide junctions at the end of all maintenance activities.
(Report No.85-051RN406BRA)

• On January 23, 1985, Senior Airman Richard Russell, a ground crew member at Bergstrom AFB, TX, was overexposed to RF radiation while inspecting an AN/ALQ-119 electronic countermeasures (ECM) pod of an F-4 jet. Russell felt heat intermittently from his knees to his chest during the procedure. After reporting the problem, Russell was examined for possible symptoms of RF overexposure. The AN/ALQ-119 ECM pod is a jamming device used to protect the fighter jet in flight. In the reenactment of the incident – which took place at Eglin AFB, FL, due to concerns for EMI – an investigator also felt the heat sensation. OEHL estimated that the average power density levels ranged from 5.7 mW/cm² at Russell's head to 147.5 mW/cm² at his hands; his chest, groin and knees were also overexposed. The system's operating frequency is classified, but the stated PEL for 1-300 GHz is 10 mW/cm².
(Report No.85-113RN017GRA)

• On February 1, 1985, a Cannon AFB, NM, technician was troubleshooting an APM-358 Microwave Signal Source Test Set Drawer for a possible microwave leak when he felt a warm sensation in his left hand. After the technician shut the system down, a cracked waveguide connector was discovered – but the USAF did not promptly investigate or examine the technician, Airman First Class Mark Innis. Only when a macule (blemish) appeared on Innis's hand five days after the incident did he undergo medical care. The drawer's output signal is between 15.7 and 16.9 GHz at 100-150 milliwatts, mitigated by a 3 dB attenuator. OEHL concluded that, "Innis's sensation of warmth in his hand is consistent with the frequency range to which he could have been exposed." Though OEHL could not recreate the incident because the defective waveguide had been replaced, investigators estimated that the technician's whole-body exposure

was no more than 5.3 mW/cm², compared to a PEL of 10 mW/cm². Officials reported that his heat sensation could be attributed to the exposure but, because no burn occurred within 24 hours of the incident, they concluded, "It is difficult but not totally impossible to link the seemingly coincidental development of a transient macule to the exposure incident." They decided that no medical follow-up exam was necessary because there was no overexposure, and they recommended that personnel adhere to safety guidelines.
(Report No.85-079RN028DRA)

• A technician at the McGhee-Tyson Airport in Knoxville, TN, was overexposed to RF radiation while conducting power amplifier performance checks on a 4.4-5 GHz AN/TRC-97A transportable communications system. On four or five nonconsecutive days between March 5 and April 3, 1985, the technician, TSgt. Larry Roberts, conducted three or four 10-15-minute power checks per day. The discovery of a defective waveguide on April 3 prompted an investigation. OEHL found that the 1,000 watt power amplifier source was reflecting as much as 300 watts two feet away, where Roberts was working. In the "worst case" scenario, OEHL calculated that Roberts was exposed to 26 mW/cm² each time he ran a performance check. The PEL at the amplifier frequency is 10 mW/cm². According to the report, RF radiation exposure effects "are not considered to be cumulative," and therefore, each exposure was considered independent. The OEHL's report did not say whether Roberts felt ill at any time, and though he underwent a medical exam, the results of that exam were not included in the report, which was released two months after the OEHL investigation. "Receipt of a completed medical evaluation...has been delayed for a number of unavoidable reasons," the report explained.
(Report No.85-104RN332FRA)

• A civilian worker painting part of the containment of a phased array radar at Eglin AFB, FL, reported feeling flushed and dizzy and suffering from headaches and "chest pressure" in June 1985. Mark Stewart had twice previously painted the containment without falling ill. All three work periods were between June 10 and June 21. The AN/FPS-85 Radar operates at 400-500 MHz, but the precise frequency is classified. OEHL investigators found that Stewart was not overexposed: although fields in the areas where Stewart might have been were as high as 12 mW/cm², the OEHL concluded that he came no closer than four feet to an active radar element and thus, most likely, was exposed to fields on the order of 0.5 mW/cm², compared to a PEL of 4-5 mW/cm². The USAF recommended that all areas of array faces "should be considered as potentially hazardous." No medical evaluations beyond the initial examination immediately following the incident were deemed warranted. Investigators noted that fields on the ground in front of the radar "greatly exceeded" the USAF safety standard and specified that these areas, which are fenced off, should be marked with radiation warning signs.
(Report No.85-148RA058HRA)

• On September 10, 1985, two airmen at Myrtle Beach AFB, SC, were overexposed to RF radiation while performing a maintenance procedure on a QRC 80-01. The device is a modified AN/ALQ-119 electronic counter measures (ECM) pod, operating in several frequency bands, all greater than 1 GHz. While repairing the device, Airmen First Class Gary Deeds and James Bell were unable to complete a mid-band balance test – they repeated the 5-10-minute procedure four times. After both men felt heat coming from the system, their instructors noticed that the QRC 80-01's dummy load was missing, indicating unintended emissions. According to the report, Deeds was anxious about having been exposed, but felt nervous about the possible repercussions of reporting the incident. He suffered "flu-like" symptoms, such as headaches and general weakness, but returned to duty after a medical examination. Measurements taken during the OEHL's investigation suggested exposures ranging from less than 0.05 mW/cm² at the airmen's heads and below their waists to 90 mW/cm² at their hands; their abdomens and waists were exposed to 30 and 50 mW/cm², respectively. Deeds was exposed four times during the incident, while Bell was exposed at least once. The PEL above 1 GHz is 10 mW/cm². According to the OEHL report, "The exposure to the hands was the only one to have been at what could be called biologically meaningful levels." The report also cited the conclusion of a medical advisor (not the doctor who examined Deeds): "The only biological response which would be expected is the perception of heat which did take place. I do not consider the 'flu-like' symptoms related to exposure – it is not a known effect." He suggested that stress, rather than RF exposure, caused the symptoms and recommended against medical follow-up.
(Report No.85-179RN137KRA)

• Three civilian workers experienced a combination of cramps, headaches, nausea and soreness after doing routine maintenance on the AN/DPS-5 Tethered Aerostat Radar System (TARS) at the Cudjoe Key USAF Station in Florida. TARS is a USAF balloon-borne surveillance radar, which operates at 3.22 GHz with a peak power of 1236 kW. One of the three men worked on TARS on April 1, 1986, and the two others worked on the system two days later. All were employed by RCA, which maintains the radar system. Billy Fortner, the worker who serviced TARS on April 1, suspected RF radiation "spill-over" and later reported cramps and soreness. Paul Williamson and Charles Lafferty, who performed power output adjustments on the radar for about 15 minutes on April 3, later reported headaches, nausea and midsection soreness. All three men were sent to a civilian hospital, which "did not differentiate between nuclear and RF radiation and therefore conducted some unnecessary procedures," according to the OEHL report. OEHL determined that none of the men were exposed to radiation levels above 1 mW/cm², compared to a PEL for occupational exposure of 10 mW/cm², and concluded that there could not have been overexposure because the men did not experience heat sensations or reddening of the skin while working. OEHL also found that Fortner's symptoms were not associated with microwave radiation because they started 20 hours after the incident and that Williamson and Lafferty, who began feeling sick within 15 minutes of the incident, probably suffered heat stress and motion sickness (the TARS radar unit rotated). The USAF recommended against further medical follow-up for the workers, but urged that an RF hazard training program be set up.
(Report No.86-044RN0088FRA)

• On June 12, 1986, two men were exposed to 0.1 mW/cm² of 4950 MHz radiation from an AN/MST-TIA (MUTES) scoring radar while painting an air conditioner on the roof of a nearby building at La Junta, CO. Airman First Class Ted Leach, the first man to be exposed, had hung warning signs on two TLQ-11 radars housed in the building where he was painting but did not post a sign on the MUTES. After 45 minutes of painting, Airman First Class Kevin Coleman relieved him. Leach then noticed flashing lights on the MUTES, indicating that it was transmitting. Coleman was exposed for no more than 10 minutes, according to OEHL investigators. In measuring radiation levels on the roof, the investigators found that neither worker was exposed to fields in excess of 0.1 mW/cm², although fields as strong as 10 mW/cm² were measured in accessible areas. The PEL at 4950 MHz is 10 mW/cm². OEHL's report concluded that written safety procedures are sufficient to control roof traffic and to prevent future exposures. The investigators found no medical evidence of overexposure and recommended against medical follow-up.
(Report No.86-070RN0063HRA)