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INSIDE...

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).

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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.

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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.

CLASSIFIEDS

Stockholm VDT Meeting Discounts

VDT News is organizing a discount flight to the international VDT conference to be held in Stockholm, Sweden, May 12-15. For more information, contact the *VDT News* office, (212) 517-2802.