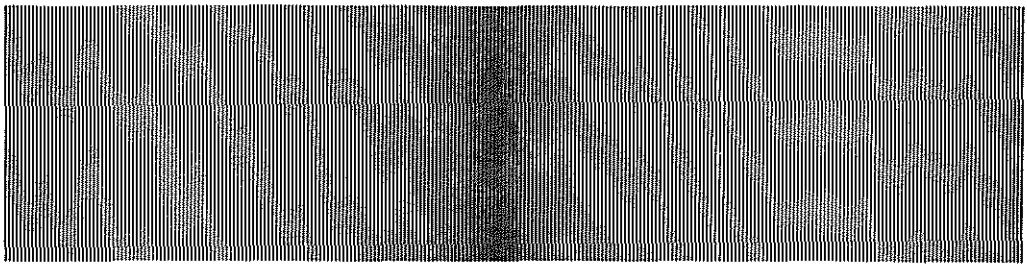


MICRO WAVE NEWS



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A Monthly Report on Non-Ionizing Radiation

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Because of the abundance of news this month, the second part of our report on the Bioelectromagnetics Society conference will appear next month.

EMC'83: A Booming Business

Problems due to electromagnetic interference (EMI) continue to intensify. It is as if an electronic domino effect is at work. Signals from FM radio and TV stations disrupt computers, whose own emissions may affect avionic systems. High frequency communications impinge on radars and weapon systems; airport radars upset computer operations. CB radios and walkie talkies spoil TV reception and play havoc with industrial machinery, which in turn interfere with aircraft flying overhead. And all of the above may hurt the performance of medical devices.

How serious are these interactions? No one knows for sure, but more and more calls are going out to EMC engineers for diagnoses and cures.

All in all, it's a good time to be in the electromagnetic compatibility business. Attendance at this year's *International Symposium on Electromagnetic Compatibility*, held in Washington, DC, August 22-25, was at near-record levels, with more than 1,000 EMC engineers registering for the technical sessions and hundreds more exhibiting their wares. And if the growing concern over EMI is any guide, there will be plenty of work to go around, transforming what used to be a somewhat arcane specialty into a technological necessity.

Outlined below are selected highlights from the EMC symposium with details on the myriad types of interactions being reported and what is being done to remedy them.

Computer RFI

The issue of susceptibility of computers to RFI was raised by William Rhoades of Xerox Corp. in El Segundo, CA. In his prepared talk, Rhoades said that as more and more digital equipment is used in high-rise buildings, interference from TV and FM stations "will become a growing problem." Similarly, computers in offices built near airports are suffering from radar interference. He said that it is easy to measure fields of 50 V/m three kilometers from an airport radar. He advises that computers be able to withstand fields greater than 1 V/m.

Xerox is not alone. An IBM engineer sitting in the audience remarked that he had encountered difficulties installing computers near Dulles Airport.

When Rhoades was asked how common computer EMI is, he replied that he knows of 15 to 20 cases involving Xerox computers in the last two years; most of these were resolved by moving the computer to a new spot in the building. But the situation may get worse in the future. The proliferation of walkie-talkies, cellular telephones and paging systems will no doubt increase the incidence of computer RFI, he said.

(continued on p. 2)

ISM Equipment

Emissions from industrial, scientific and medical (ISM) equipment, believed to be the largest source of man-made radio noise, are the subject of intense negotiations in international circles. US manufacturers are resisting voluntary ISM emission limits adopted by the International Special Committee on Radio Interference (CISPR) as too strict and too expensive, even though US standards are widely recognized as overly lax. Some compromise must be reached in the next few years because a resolution passed at the 1979 World Administrative Radio Conference (WARC) mandates that new limits be agreed upon to protect communications technology and aeronautical navigation equipment.

The International Radio Consultative Committee (CCIR) has set up an Interim Working Party 1/4, under the chairmanship of Professor R.G. Strusak of Poland, to recommend new limits. (FCC's Art Wall is representing the US in these talks.) The working party will prepare a report by the end of 1984 for action by CCIR in 1986. New standards will probably be ratified by an international treaty and will be adopted by the Federal Communications Commission (FCC).

Tests to determine the impact of ISM interference on the Instrument Landing System (ILS) are underway at Ohio University's Avionics Engineering Center in Athens. The fourth harmonic (107.83-109.13 MHz) of ISM equipment operating in the 27 MHz band can impinge on the ILS localizer aeronautical service in the 108-112 MHz frequency band. Principal investigator James Nickum at Ohio University is in the process of measuring radiation levels aboard aircraft flying over factories with ISM equipment. A final report should be ready for the Federal Aviation Administration (FAA) by next summer.

An FAA staffer said that a number of complaints of ISM interference have been received but he could not cite precise statistics.

Computers Aboard Aircraft

Another possible hazard to aircraft operations is interference caused by portable computers used by passengers. A lead article in the August 22 *InfoWorld* reports that Eastern Airlines has banned the use of portable computers on its flights and that some commuter airlines have similar prohibitions. But there are no industry-wide rules, and each air carrier has the discretion to set its own policy. In the August 29 issue, *InfoWorld* editors advise: "Until portable computers have been flight-tested in a reasonable fashion by experts from the aviation, electronics and computer industries, passengers would be better off to leave the computer off and, as one critic put it, 'Sit back and enjoy the flight.'"

Computer EMI aboard aircraft was discussed at last May's Executive Committee meeting of the Radio Technical Commission for Aeronautics (RTCA). Aeronautic Radio Inc. (ARINC), based in Annapolis, MD, has been looking into the issue and weighing the possibility of asking RTCA to set up a special committee to review the need for formal

rules. No action has yet been taken however, because, as ARINC's Richard Climie explained to *Microwave News*, "We do not know of any substantiated cases of computers or any other devices causing an [EMI] problem." Climie said that he had heard of some incidents, but they could not be verified. RTCA action is on hold until concrete data are in hand.

Power Lines & Railroads

Railroads have their own EMI problems. Preliminary studies at the IIT Research Institute (IITRI) in Chicago, IL, indicate that power lines sharing the right-of-way with railroads can play havoc with railway signaling systems. In an award-winning paper presented at the EMC meeting, IITRI's Allen Taflove said that he had found a "false clear" failure caused by induced voltages as low as 0.1 volts. A false clear, which occurs when a red light mistakenly changes to green, is the most serious type of signaling error.

While calling these results "most disquieting," Taflove cautioned that his study, funded by the Electric Power Research Institute (EPRI), had only "scratched the surface" of the problem and that his results should be seen as tentative for the present. But he was unequivocal about the need for further testing: "Someone somewhere should do thorough, statistically significant testing—it's a question of public safety."

Taflove was critical of the "total neglect" of this issue, which has cost the utilities millions of dollars. He said that the Department of Transportation (DOT) was unaware of this type of EMI. EPRI will soon issue a three-volume report on the IITRI study.

Taflove did not investigate the EMI to electrified rail systems. This is an area that DOT is addressing. The Rail Transit EMI/EMC Program at DOT's Transportation Systems Center in Cambridge, MA, provides a forum for experts from all over the world to advance the state of the art in subway and trolley transit systems. Those interested in more information should contact Bud Gingrande at the DOT center, (617) 494-2000.

Industrial Machinery

Can stray radio signals affect industrial equipment and robots? John Bloodgood thinks so. Bloodgood, who is a consultant working out of Fond du Lac, WI, is urging expert committees to set standards to relieve a problem he says is "becoming more and more severe."

In a post-symposium presentation to the American National Standards Institute's (ANSI) C63 Committee on Radio-Electrical Coordination, Bloodgood cited these examples: Numerical control equipment at a major producer of farm machinery began starting by itself without any identifiable cause. An investigation later indicated that a CB radio was responsible. In another plant, for no known reason a radio-operated crane began to move on its own, lowering a heavy casting. This latter incident nearly resulted in a loss of life. Bloodgood said that industrial users are worried and are beginning to demand fail-safe systems.

Medical Devices

A task group of ANSI C63 subcommittee 1 is considering the need for setting limits for radiated emissions from medical devices and guidelines for their susceptibility to EMI. Howard Bassen of the Food and Drug Administration (FDA) is in the process of determining whether FDA staff will help develop and write a document on medical device EMI. Al Smith, Jr. of IBM is already preparing a report on test methods for medical devices.

According to Bassen, some years ago McDonnell-Douglas prepared an EMC standard for medical devices under an FDA contract. The standard was heavily criticized, however, and neither the agency nor ANSI adopted it. Industry representatives protested that there was no evident need for it.

Naval Weapons Systems

The US Navy has the most intractable EMI problems. Engineers must find room for scores of radar and communication systems aboard navy ships. Dr. Robert Haislmaier, the navy's EMC coordinator, says this is much harder than siting terrestrial systems. For example, the ship's high frequency (3-30 MHz) transmissions can interfere with radar, TACAN and electronic warfare systems as well as the ship's overall operation.

Haislmaier's strategy is to "institutionalize" EMI control to guarantee combat readiness. The navy has hired half-a-

dozen contractors and has commissioned computer programs to help fix problems quickly. Fleet personnel are being trained to increase their awareness of EMI; according to Haislmaier, preventive maintenance is the key to correcting weaknesses before they deteriorate performance. He told *Microwave News* that the Chief of Naval Operations, to whom he reports, is interested in EMC and has directed his staff to develop a program to remedy the situation. Haislmaier predicted that "if we can keep the momentum up the navy will be in a substantially improved posture in five years."

The same concerns were echoed by Milton Kant of RCA, who works on the Aegis weapon system. "There is no doubt that EMC is important," he said, "it is a recognized and continuously examined factor in the ship-building program." He pointed out that EMI is not a major issue with the Aegis because it was designed with compatibility in mind. But, he added, retrofitting can be very expensive and sometimes ineffective. The Aegis is hardened to electromagnetic pulse (EMP) radiation which takes care of HF communications EMI. Kant said that the present trend is to protect all navy ships from EMP.

Neither Haislmaier nor Kant were willing to detail specific navy EMI concerns because of the risks to national security. In fact, some 20 papers scheduled to be presented at the meeting were pulled due to lack of clearance, and one paper on "EMP Hardening of Navy Ships" was torn out of the bound volume of the symposium record. ●

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Microwave Radiation Information and Action Center offers specialized information resources and legal services regarding exposure to non-ionizing radiation. Contact: J. Stuart Lemle, Executive Director, 1701 K Street, NW, Suite 1000, Washington, DC 20006, (202) 775-0044.

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New Soviet RF/MW Standards; US-USSR Bioeffects Workshop

Safety standards for exposures to radiofrequency and microwave (RF/MW) radiation in the Soviet Union are changing. The new occupational standard is 100 $\mu\text{W}/\text{cm}^2$ for two-hour exposures to radiation in the 300 MHz-300 GHz frequency band. A new standard for the general population is expected, although no official announcement of proposed revisions has been made.

In a paper recently received from the USSR, Professor B.M. Savin and colleagues at the Moscow Institute for Industrial Hygiene and Occupational Diseases of the USSR Academy of Medical Sciences state that the validity of an occupational standard of 100 $\mu\text{W}/\text{cm}^2$ "has been proven by 20 years of practice and supported by experimental studies."

Savin concludes that, "Radiation exposure at low levels can be measured via the energy (W) delivered to the organism and expressed through the product of the power density (P) and the exposure duration (T): $W = P \times T$ " and therefore $P = W/T$. With a 100 $\mu\text{W}/\text{cm}^2$ limit for two hours, the allowed energy load is 200 $\mu\text{W}/\text{cm}^2 \times \text{h}$. For one hour exposures, the maximum exposure is 200 $\mu\text{W}/\text{cm}^2$; for exposures of 6 to 25 minutes, the limit is 1 mW/cm^2 .

The new standard is based on a damage threshold of 1 mW/cm^2 for two hour exposures with a factor of ten safety margin.

These revisions described in "Changes in Microwave Radiation Exposure Standards" are codified in *Amendment No. 1 of 11/182 to State Standard 12.1.006-76 "Electromagnetic Radiofrequency Fields: General Safety Requirements."* These changes are in agreement with reports by US scientists who visited the USSR last year (see *MWN*, November 1982).

Dr. Clifford Mitchell of the National Institute of Environmental Health Sciences (NIEHS) in Research Triangle Park, NC, brought Savin's paper back from the USSR in June. It was translated by Drs. Gabriel Jakobson and David Davidson of GTE Labs in Waltham, MA.

Soviet occupational exposure standards below 300 MHz are still being developed, according to Mitchell. He said that experiments are now underway at these frequencies to form the basis of these new limits.

A new Soviet population standard is also in preparation. In an interview at the June Bioelectromagnetics Society meeting in Colorado, Professor Mikhael Shandala of the A.N. Marzeev Research Institute of General and Communal Hygiene in Kiev said that a document with proposed recommendations should be ready by the end of this year. When completed, it will be forwarded to the Ministry of Health in Moscow and undergo peer review by a committee of experts. Once reviewed, Shandala's group in Kiev will revise the document.

The present RF/MW standard for the general population

is 5 $\mu\text{W}/\text{cm}^2$. Shandala did not disclose what the new standard might be, nor is it clear when the new standard will be promulgated. He did send *Microwave News* some comments on standard setting in the USSR (see "From the Field" p.12).

Shandala was in the US to attend the *Fourth US-USSR Workshop on the Biological Effects of Physical Factors in the Environment*, held at NIEHS, June 21-22. Thirteen American and five Soviet scientists presented papers and devised a work plan for 1983-1984. A number of Soviet participants, including Professor Inal Akoef of the Institute of Biological Physics in Pushchino, were unable to attend (see *MWN*, June 1983). A fifth workshop will be held in the USSR in 1985. In addition, there are tentative plans to hold a meeting next year, also in the USSR, on the duplicative experiment, in which rats are exposed to 2450 MHz microwaves at 10 mW/cm^2 in both countries (see *MWN*, July/August 1982).

Under the work plan for continued US-USSR cooperation, bioeffects research will continue on the: (1) biological effects of microwave radiation; (2) biological effects of static and low frequency electromagnetic fields; and (3) the duplicative experiment. The new work plan was signed by NIEHS' Dr. Don McRee and Dr. Shandala on June 23.

Specific studies in the US include the development of models of the creation and propagation of solitons in helical proteins; the demodulation of ELF electric fields by cell membranes; behavioral effects of chronic, low-level exposures to 915 MHz radiation; the interaction of microwaves with drugs in the central nervous system; the short and long term effects of ELF (1-60 Hz) on neuron excitability; power frequency electric fields inside the bodies of live rats; and the effects of air ions and electric fields like those from DC transmission lines.

In the USSR, research is planned on the effects of 857 and 1765 MHz pulsed fields; the risks due to exposure to TV broadcast signals (30-300 MHz); the bioeffects, including some studies on mutagenesis, of stationary electric fields (20-80 kV/m), 50 Hz fields (10-100 kV/m) and 7 kHz magnetic fields as well as continued work on the duplicative experiment.

NY Power Lines Project To Fund Two Epidemiological Studies

The Scientific Advisory Panel of the New York State Power Lines Project is negotiating contracts for two epidemiological studies on the relationship between alternating magnetic fields (AMFs) and cancer rates among children and adults.

The panel has selected proposals from Dr. David Savitz of the University of Colorado in Denver and Dr. Lowell Sever of Battelle Pacific Northwest Labs in Richland, WA.

If details can be ironed out, Savitz's project will be similar to Dr. Nancy Wertheimer's study, which indicated an association between AMFs from power lines and childhood cancer. The decision to repeat Wertheimer's 1979 study follows a recommendation by Dr. Annemarie Crocetti, a consultant to the panel (see *MWN*, June 1983). Dr. Richard Hamman will serve as an in-house consultant for Savitz's project. Sever will run a case control study to look at the possible connection between power lines and the rates of a still to be specified type of adult cancer.

According to project administrator Michael Rampolla, budgetary constraints played a key role in the panel's choice. (Proposals from Dr. Tim Byers of the State University of New York at Buffalo and Dr. Jerome Barancik of the Brookhaven National Laboratory in Upton, NY, were also under consideration.) Savitz and Sever have been asked to modify their research designs to trim costs, but the two contracts will still require more than the \$600,000 originally slated for epidemiological research.

Rampolla reports that, barring any last minute complications, contracts will be signed in October.

FCC Inquiry on RF Lighting

The Federal Communications Commission (FCC) has issued a notice of inquiry (NOI) on the potential for radiofrequency (RF) lighting devices to interfere with radio communication services.

The commission is evaluating the need for regulations to minimize potential radiofrequency interference (RFI) from the devices and has asked interested parties to respond to some 42 specific questions by October 31. Reply comments are due December 16. Rather than set its own standards to control RF emissions, the FCC would prefer industry to regulate itself with voluntary standards.

RF lighting, in which 60 Hz AC power is converted to RF energy at a frequency above 20 kHz which excites a fluorescent tube, is much more efficient than conventional incandescent and fluorescent lighting. For instance, General Electric has developed an RF light bulb which fits into a conventional socket but uses only one third the energy of an incandescent bulb and lasts four times as long. Other companies producing various types of RF lighting devices are North American Phillips Lighting Corp., International Energy Conservation Systems and a partnership of Soli-Tronics and Brigham Young University.

With electronic and RF ballasting becoming more cost effective, and with energy costs going up, the FCC anticipates that RF devices could win a significant share of the lighting market, causing more RFI. FCC tests indicate that RF bulbs emit broadband radiation in the frequency range from 10 kHz to 80 MHz which could interfere with AM radio reception.

Under current FCC rules, RF lighting devices are covered under Part 18, Subpart H. The commission believes that these rules were not designed to apply to mass produced consumer goods, and that they are not sufficiently strict to

prevent objectionable RFI. FCC test data indicate that RF bulbs can meet much tighter limits, similar to those controlling computer emissions (Part 15).

In a separate action, the FCC has granted waivers to three companies to test market a limited number of RF lighting devices. Under the ruling, the companies will be free of the FCC requirement to test the devices every three years, but each must submit reports to the FCC on RFI problems every three months.

For more information contact: Herman Garlan, Office of Science and Technology, FCC, Washington, DC 20554, (202) 653-8247. The NOI and the notice of waivers appear in the August 17 *Federal Register*, 48 FR 37235 and 48 FR 37217, respectively.

Massachusetts Adopts RF/MW Standard; Town Rule Overturned

Massachusetts has become the first state to adopt a general population exposure standard for radiofrequency and microwave (RF/MW) radiation. The standard approved by the Public Health Council on August 9 limits exposures for the 30-300 MHz frequency band to 200 $\mu\text{W}/\text{cm}^2$ and is five times more stringent than the American National Standards Institute's (ANSI) 1982 guidelines.

Immediately after the council's decision, the State Attorney General's office overturned RF/MW regulations for exposures over 5 $\mu\text{W}/\text{cm}^2$ recently adopted by the town of Wayland (see *MWN*, June 1983). In an August 11 letter, Assistant Attorney General Henry O'Connell told Wayland administrators that under state law the Department of Health's rules for non-ionizing radiation "shall apply *exclusively* throughout the Commonwealth." Citing the new state standard, he concluded that "the proposed [Wayland] bylaw is inconsistent with state action in an area preempted by the state."

The final Massachusetts standard is very similar to earlier drafts (see *MWN*, March and December 1982 and June 1983) but does contain two last-minute additions. Regulators inserted a clause explicitly stating that federal guidelines will supersede state rules, should a conflict arise. Massachusetts has its eyes on the Environmental Protection Agency, which is scheduled to release a draft RF/MW exposure guidance later this year.

The other addition is an assurance that the state will consider other guidelines or regulations not related to public health if requested to do so by Federal Communications Commission (FCC) licensees. Such a request might come from a broadcaster forced to choose between violating FCC power requirements and the standard.

According to Robert Watkins of the state's Radiation Control Program, the regulations will not affect any existing RF/MW sources. Operators intending to alter their facilities, as well as applicants for new sources, must demonstrate compliance, however. The standard covers the spectrum from 300 kHz to 100 GHz: 200 $\mu\text{W}/\text{cm}^2$ for the 30-300 MHz band rising to 1 mW/cm^2 for frequencies above

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1500 MHz and to 20 mW/cm² for those below 3 MHz.

The standard, which goes into effect October 1, was published in the *Massachusetts Register*, No. 379, on September 1. The register is available for \$1.90, prepaid by check, from the Statehouse Bookstore, Room 116, Massachusetts Statehouse, Boston, MA 02133.

FCC Test Methods for Computer RFI Simplified

The Federal Communications Commission (FCC) has clarified its recommended procedures for measuring radiofrequency (RF) emissions from computers. The procedures were adopted in 1981 to help manufacturers demonstrate compliance with regulations to control RF interference.

The minor alterations released in late July came in response to a 1981 petition from the Computer and Business Manufacturers Association (CBEMA). In addition to adopting several of the trade group's suggestions, the commission announced its intention to publish the measurement procedures as a separate bulletin rather than keep them as an appendix to its Part 15, Subpart J regulations for computer radiofrequency interference.

According to the FCC's Julius Knapp, the changes should add more "flexibility" to the test procedures.

CBEMA spokesman Bill Hanrahan said the group is pleased with the changes, though it does not support separating the suggested measurement methods from the RF emission regulations themselves. CBEMA feels the move will make it more difficult for manufacturers to keep up with future guideline revisions. The commission maintains that separate publication is more efficient because the interested audience is very small.

Among the clarifications and revisions in the recommended test procedures:

- Equipment should be configured to maximize emissions, but not necessarily to an absolute "worst case" condition cited in the original text. The specific configuration is left to the test engineer.
- Manufacturers are no longer advised to test equipment with each cable that may be used. Instead, the commission recommends testing with cable lengths likely to produce maximum radiation emissions.
- Emissions from Class A devices (used by industry or business) may now be measured at a distance of up to 30 meters. The commission recommends limiting the distance for Class B devices (intended for residential use) to 3 meters, but greater distances are acceptable if justified. CBEMA had recommended deleting the original 3-meter distance requirement for both classes.
- The commission clarified how it will treat equipment tested before its RF interference requirements went into effect on July 1, 1981. It reserves the right to evaluate test procedures and to investigate reported problems. As in the original rules, these devices do not need to be retested.

The FCC notice also answers questions submitted over the past two years by other parties.

As noted in the August 1 *Federal Register* (48 FR 34748), the test methods will be available soon as Office of Science and Technology Measurement Procedure MP-4, *FCC Methods of Measurement of Radio Noise Emissions From Computing Devices*. The original FCC guidelines were published on April 24, 1981 (46 FR 23240). For further information, contact Julius Knapp, Office of Science and Technology, FCC, Washington, DC 20554, (202) 653-8247.

NRPB Reports on RF/MW Sources and Standards

A new report by the UK's National Radiological Protection Board (NRPB) examines exposures from radiofrequency and microwave (RF/MW) radiation sources relative to suggested revisions in safety standards. The NRPB anticipates that the new standards, proposed by the board late last year, would have only minimal impact on radiation emitting technologies. Some industrial heating equipment and radar and weapons systems are possible exceptions.

The Board states that, under the proposed limits, industrial heating is "likely" to be "more costly and possibly impracticable" in certain operations unless it can be established that the human body absorbs much less energy in the near field than in the far field (assuming the same external field strength). The same problems may also exist for some portable and mobile broadcast equipment—unless emission standards are set.

With respect to radar and weapons systems, the NRPB concludes that lowering exposure standards for the general population from 10 mW/cm² to 5 mW/cm² "may require an extension of the existing boundary limits of some controlled areas by 40 percent from the source." But, the board notes this may not be necessary if allowances are made for the "rotation or nodding" movement of the radiating source.

The board calls for further study of "rates of energy absorption related to field intensities at distances well within a wavelength from the radiating sources," and suggests more attention be directed to how the near field is modified by environmental factors.

The NRPB report follows last year's recommendations for revisions in RF/MW safety standards which proposed two sets of exposure limits: one for occupationally exposed adults and one for the general population, including children. The two are identical in the 3-100 MHz frequency band, but the latter is more stringent above 100 MHz. For workers, the maximum allowed exposure would be 1 mW/cm² for 3-100 MHz, rising to 10 mW/cm² at 1 GHz. For the general population, the allowable level would remain at 1 mW/cm² up to 300 MHz and then only rise to 5 mW/cm² at 1.5 GHz. The proposal extends the frequencies covered by the standards from 30 MHz-30 GHz to 3 kHz-100 GHz.

The occupational limits are identical to those adopted by

the American Conference of Government and Industrial Hygienists (ACGIH) in May. Those for the general public are the same as the 1982 American National Standards Institute guidelines.

In a personal communication to *Microwave News*, NRPB's Frank Harlen said that no timetable has yet been set for the adoption of the new standards.

The new limits are based on the assumption that "exposures resulting in a mean specific energy absorption rate in the whole body of less than 0.4 W/kg" are "acceptable" and provide "an adequate margin of safety."

The NRPB also states that exposures to power line frequency (50 Hz in the UK) fields of less than 10 kV/m are

"safe although the field may be perceptible at lower values." In addition, the board advises that exposures to fields as high as 30 kV/m are "unlikely to be harmful."

Sources of Exposure to Radiofrequency and Microwave Radiations in the UK (No. NRPB-R144) by S.G. Allen and F. Harlen, *Proposals for the Health Protection of Workers and Members of the Public Against the Dangers for Extra Low Frequency, Radiofrequency and Microwave Radiations: A Consultative Document* and a summary of the proposed standard by F. Harlen and J.A. Dennis published in the NRPB's May 1983 *Radiological Protection Bulletin* (No. 52) are all available from the NRPB, Chilton, Didcot, Oxon, OX11 0RQ, England.

CONFERENCES

September 28-30: International Workshop on Electrostatics: How to Manage Electrostatic Problems, Hazards and Applications, Llandudno, North Wales, UK. Contact: Ms. Helen Raquet, Oyez Scientific and Technical Services, Ltd. Bath House, 56 Holborn Viaduct, London EC1A 2EX, England.

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

October 4-6: LPTV '83 East, Sheraton Washington, Washington, DC. Contact: Conference Management Corp., 17 Washington St., PO Box 4990, Norwalk, CT 06856.

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

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

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

November 7-9: Department of Energy and Electric Power Research Institute Contractors Review, Hilton Plaza Inn, Kansas City, MO. Dr. William Wisecup, Aerospace Corp., 955 L'Enfant Plaza, SW, Suite 4000, Washington, DC 20024.

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

November 8-11: 29th Annual Conference on Magnetism and Magnetic Materials, Hilton Hotel, Pittsburgh, PA. Contact: F.E. Werner, Westinghouse R&D Center, 1310 Beulah Rd., Pittsburgh, PA 15235.

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

November 16-17: JINA 83, (2emes Journees Internationale de Nice sur les Antennes), Nice, France. Contact: J.L. Guiraud, Centre National

d'Etudes des Telecommunications, Centre de La Turbie, 06320 Cap D'Ail, France.

December 8-9: Radiation and Energy: Confronting the Challenges of the Eighties -Law, Regulation, Risk Liability, Litigation and Compensation, New York, NY. Contact: James Lawrence, Lloyd's of London Press, 817 Broadway, New York, NY 10003.

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

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

January 17-19: Instrumentation & Measurement Society Technology Conference (IMTC) 1984, Aboard the Queen Mary, Long Beach, CA. Contact: Robert Myers, 1700 Westwood Blvd., Suite 101, Los Angeles, CA 90024.

February 6-8: NIH Consensus Development Conference on Use of Diagnostic Ultrasound Imaging in Pregnancy, National Institutes of Health, Bethesda, MD. Contact: Michaela Richardson, NIHCD, Bldg. 31, Room 2A32, 9000 Rockville Pike, Bethesda, MD 20205.

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

March 13-14: 1984 National Radar Conference: Radar Technology for the 80's, Atlanta, GA. Contact: Dr. Edward Reedy, Georgia Institute of Technology, Engineering Experiment Station, Radar & Instrumentation Lab, Atlanta, GA 30332.

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

April 14-19: 19th Annual Association for the Advancement of Medical Instrumentation Meeting and Exhibit, Washington Hilton, Washington, DC. Contact: AAMI, 1901 North Fort Myer Drive, Suite 602, Arlington, VA 22209.

April 24-26: IEEE 1984 National Symposium on Electromagnetic Compatibility, Hyatt Regency Hotel, San Antonio, TX. Contact: William McGinnis, Southwest Research Institute, PO Drawer 28510, San Antonio, TX 78284.

BIOLOGICAL EFFECTS

New AF Contracts...The Air Force School of Aerospace Medicine at Brooks AFB, TX, has awarded two contracts for studies on VLF (10 kHz to 3 MHz) radiation hazards (see *MWN*, May 1983). Dr. A.W. Guy of the University of Washington, Seattle has received \$170,000 and Dr. Om Gandhi of the University of Utah, Salt Lake City has received \$90,000 for the 13-month research projects....And the AF has awarded Dr. Robert Lebovitz of the University of Texas Health Science Center in Dallas approximately \$150,000 for a two-year study of the effects of microwaves on the reproductive function of rats. Lebovitz will expose rats to 1.3 GHz radiation at SARs of 0.5-10 W/Kg and will investigate sperm production and morphology.

Polycythemia Follow-Up...Last August, 25 cases of polycythemia vera were reported near the Savannah River plant in South Carolina, where weapons-grade plutonium is produced. The implication was that ionizing radiation was responsible for this abnormal incidence of blood disease (see *MWN*, September 1982). Officials from the Center for Disease Control (CDC) set out to track down the cases and to see if there was a common thread linking them. The report caught the attention of the RF/MW community because in 1981 an army pathologist reported what he believed to be an association between microwave exposure and polycythemia (see *MWN*, March 1981). After a year of field work, CDC investigators have failed to locate most of the 25 people involved. CDC's Dr. Jeffrey Lybarger was able to confirm only a very small number of cases — many of them were discredited. CDC's interest lies not only in checking out this cluster but also in doing basic research on polycythemia. Lybarger said that an epidemiological study could still be done, if it is deemed worthwhile by senior CDC staff.

Resources...Allan Frey of Randomline Inc. in Huntingdon Valley, PA, and Alan Segal and Richard Magin of the University of Illinois in Urbana-Champaign exchange views on research on the effects of microwaves on the blood-brain barrier in Volume 2, Number 1 of the *Journal of Bioelectricity*....Dr. Herbert Pollack's paper, "Medical Aspects of Exposure of Radiofrequency Radiation Including Microwaves," appears in the June issue of the *Southern Medical Journal*. Pollack, who is associated with the George Washington University School of Medicine, wrote the article for the general medical practitioner....Drs. Richard Olsen of the Naval Aerospace Medical Research Lab in Pensacola, FL, and James Lin of the University of Illinois in Chicago have published "Microwave-Induced Pressure Waves in Mammalian Brains" in the May issue of the *IEEE Transactions on Biomedical Engineering*....There was a session on microwave standards at the annual convention of the American Psychological Association held in Anaheim, CA, in late August. Drs. Eleanor Adair, Don Justesen, Richard

Lovely, Mary Ellen O'Connor and F. Kristian Storm participated in the discussions that were held under the general title "Physiological Psychology Does Impact on Public Concern and Policy."

COMPATIBILITY & INTERFERENCE

More on Immunity...Don Heirman of AT&T Information Systems (the new name for American Bell) presented a status report on ANSI C63's ad hoc committee, which is studying ways of reducing RFI to home electronic equipment, at a C63 meeting on August 26 in Washington, DC (see *MWN*, May and July/August 1983). Heirman plans to have a draft interim standard on radiated immunity, methods of measurement and preliminary performance limits by next April 1. At the C63 meeting there was some discussion of which types of equipment should be addressed after work is completed on the number one priority items, TVs and VCRs. The consensus was that the next order of business should be telephone equipment, including cordless telephones, followed by home security devices. GE's Harold Gauper Jr. has become the ad hoc group's vice-chairman; its next meeting is planned for October 26. The date of the next meeting of ANSI C63 was left up in the air — either next January or April. (See also EMC story on p.1 for some details on C63 deliberations.)

Radio Noise Meeting...There will be a two-day meeting on radio noise in Washington, DC, in mid-October sponsored by the US government. On the agenda will be reviews of available noise models and measurements as well as future R&D needs. Attendance will be limited to American citizens with a "Secret" security clearance. For more information, contact: Ms. J. Brown, SRI International, 1611 N. Kent St., Arlington, VA 22209.

Resources...The IEEE EMC Society has published indexes of all papers published in the *IEEE Transactions on Electromagnetic Compatibility* from 1959 to 1982 and those presented at EMC symposia from 1962 to 1982. The indexes, prepared by Richard Schulz and Andrew Farrar, together with a brief history of the EMC Society on the occasion of its 25th anniversary appear in the August issue of the *EMC Transactions*. Copies are \$6 for IEEE members and \$12 for non-members from the IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854....The proceedings of the 8th International Aerospace and Ground Conference on Lightning and Static Electricity, held in Fort Worth, TX, June 21-23, are available from the National Technical Information Service (NTIS), Springfield, VA 22161. Report No. DOT/FAA/CT83/25....Robert Olsen of Washington State University in Pullman has published "Radio Noise Fields Generated by Corona Streamers on a Power Line" in the May-June issue of *Radio Science*....The Electronic Industries Association has released *Interference Criteria for Mic-*

rowave Systems in the Private Radio Services, EIA Telecommunications Systems Bulletin 10-D. It covers both digital and video criteria in addition to analog message interference criteria and should be of interest to licensees and planners of FCC Part 94 microwave systems, as well as those licensees who may be displaced from the 12.2-12.7 GHz band as a result of action in FCC Docket 82-334. Bulletin 10-D, which replaces the 1976 Bulletin IEB 10-C, is available for \$17 from EIA's Engineering Dept., 2001 Eye St., NW, Washington, DC 20006.

GOVERNMENT

FMAC...A Frequency Management Advisory Council (FMAC) meeting on July 29 brought members up to date on EPA's RF/MW guidance development and on the recent flurry of major international conferences on spectrum management. An FMAC group headed by Ed Weppeler is now developing recommendations to help NTIA aid industry in avoiding RFI problems. A report on NTIA's efforts should be ready by FMAC's next meeting on September 21. High definition TV and the next International Telecommunications Convention are also on the September agenda.

MEASUREMENT

Satcom Earth Stations...NBS' Electromagnetic Fields Division has revised its *Earth Terminal Measurement Systems Operations Manual* (NBSIR 83-1679). The manual describes in simple English how to measure satellite earth stations for noise and other engineering parameters and can be used even by those unacquainted with the NBS measurement system. A copy is available from the National Technical Information Service, Springfield, VA 22161 for \$28. Order No. PB 83-189928.

In the Near Field...In our January/February 1983 issue, we reported that NBS researchers had shown the theoretical feasibility of building a meter that can measure the electric and magnetic fields simultaneously in the near field. Now NBS' Dr. Motohisa Kanda has written a detailed report, complete with illustrations, describing the theory behind this new sensor. NBS Technical Note 1062: *An Electric and Magnetic Field Sensor for Simultaneous Electromagnetic Near Field Measurements - Theory* is available from the Superintendent of Documents, US Government Printing Office, Washington, DC 20402 for \$4.50.

MEDICAL APPLICATIONS

Hyperthermia Operator Safety...Operators of the Magnetode hyperthermia unit who stay more than 1 meter away from the device will not be exposed to radiation levels in excess of the ANSI safety recommendations (4.9 mW/cm^2), according to a report in the July 1983 *Health Physics*. The Magnetode unit, which operates at 13.56 MHz with an

output power of up to 1,000 watts, is used in cancer therapy. M.A. Stuchly, M.H. Repacholi and D.W. Lecuyer ran tests using human-scale phantoms placed inside the Magnetode's whole body electrode. The minimum safety distance is 2 meters under the Canadian safety code (1 mW/cm^2). They found smaller minimum distances at lower than a 1,000 W power setting, as well as when the unit's neck or thigh electrodes are used. The researchers from the Canadian Radiation Protection Bureau show that magnetic field strengths near the unit are consistently higher than electric field strengths. "To assess whether exposure to the operator is within the recommended limits, it is sufficient to examine the intensities of the magnetic field," they report.

Ultrasound During Pregnancy...NIH and FDA are sponsoring a three-day *NIH Consensus Development Conference on Use of Diagnostic Ultrasound Imaging in Pregnancy*, at NIH in Bethesda, MD, February 6-8. The meeting will address the types of ultrasound in obstetric practice and their risks to mother and fetus. For more information, contact Michaela Richardson, NIHCD, Bldg. 31, Room 2A32, 9000 Rockville Pike, Bethesda, MD 20205, (301) 496-5133.

MILITARY SYSTEMS

Project ELF Suit...The US District Court for Western Wisconsin will hear arguments in the state of Wisconsin's suit against the navy's Project ELF submarine communications system beginning September 20 (see *MWN*, July/August 1983). The judge has scheduled a hearing on Wisconsin's motion for an injunction against the ELF system until the navy prepares a new environmental impact statement as well as a trial on the merits. The state of Michigan has not joined Wisconsin in the case, but Michigan's Marquette County does plan to intervene as a co-plaintiff. Among those testifying for Wisconsin are Drs. Robert Becker and Nancy Wertheimer. The navy plans to call Drs. Annemarie Crocetti, Don Justesen and Anthony Valentino and a number of navy, GTE and IITRI personnel.

More on Microwave Weapons...Last May, we ran an item on the growing interest in EMP and RF/MW weapons. AP reporter Barton Reppert has been looking into this and confirms that the US "is quietly stepping up research on microwave beam weapons." In his August 12 story, Reppert writes that, according to Pentagon researcher John Bachkosky, high power microwave weapons involve fewer technological hurdles than either high energy lasers or particle beams. Bachkosky said that US research efforts in the microwave area are aimed largely at studying the vulnerability of various electronic components and weapon systems to high intensity microwave bombardment. Reppert also cites Edward Brown of the army's Harry Diamond Labs on progress towards the development of a tactical microwave weapon system: "We're in the realm of the possible. We're not in the realm of the probable, yet."

POWER LINES

More from Montana...A deal struck between three environmental groups and the Montana Power Company has cleared the last obstacle to building a 500 kV power line from Garrison, ND to Spokane, OR. The Montana Wildlife Federation, the National Wildlife Federation and Trout Unlimited dropped an appeal to force the National Forest Service to reconsider whether certain land along the route in Montana should be declared a wilderness area in exchange for a \$1.65 million fund to limit the line's environmental impact. Montana Power and four other utilities involved in the project will provide the money. The Forest Service issued construction permits to the line's builder, the Bonneville Power Administration (BPA), immediately after the agreement was reached in August. In a separate action reported in our July/August issue, Montana's Board of Natural Resources and Conservation this summer adopted a 1 kV electric field limit at the edge of the line's right-of-way (ROW) on residential or subdivided property. According to BPA's Deputy Chief Engineer Jerry Flick, BPA has not responded to the new requirement because it only applies to the Garrison-Spokane line, which will not pass through any land affected by the ruling. He said BPA would contest the 1 kV limit as too restrictive if the board starts proceedings to make it a state-wide standard. The board made a point of addressing health hazards with the 1 kV limit requiring a 160 foot ROW, but in fact mandated an even greater ROW, to 205 feet in developed areas, to limit noise levels.

DOE-EPRI Meeting...This year, the Department of Energy (DOE) and the Electric Power Research Institute (EPRI) are holding a *joint* meeting to review the research of their contractors. The open meeting will be held at the Hilton Plaza Inn in Kansas City, MO, November 7-9. Abstracts of the reports to be presented will be available before the meeting. Anyone planning to attend or who would like a copy of the abstracts should contact Dr. William Wisecup of The Aerospace Corp. in Washington, DC, as soon as possible, (202) 488-6328.

STANDARDS

Toward a Population RF/MW Guidance...A special panel of EPA's Scientific Advisory Board (SAB) will meet September 22-23 in Washington, DC, for the first public review of the agency's draft report on RF/MW bioeffects. The report will be the basis of EPA's general population exposure guidance (see *MWN*, July/August 1983). The meeting will start at 9:15 AM in Room 2123 at EPA headquarters, 401 M Street, SW. Those wishing to present comments should contact SAB's Dr. Terry Yosie at (202) 382-4126 or Dr. Douglas Seba at (202) 382-2552. To meet a greater than anticipated demand, EPA has printed more copies of its report, *Biological Effects of Radiofrequency Radiation*, No. EPA-600/8-83-026A, which is available from the Center for Environmental Research Information, EPA, Cincinnati, OH 45268, (513) 684-7562....Dr. Daniel

Cahill, who preceded Dr. Joe Elder as head of the Experimental Biology Division at EPA's Health Research Lab, has suggested setting an interim federal RF/MW exposure guidance for the general public that is five times lower than ANSI's 1982 revised levels and identical to Massachusetts' recently adopted standard (see story on p.5). In an article appearing in the July *Health Physics*, Cahill concludes that, based on EPA's bioeffects literature review, a maximum specific absorption rate of 0.04 W/kg (equivalent to 200 μ W/cm² for the 30-300 MHz band and higher for frequencies above and below this range) would provide a factor of ten safety margin against "potentially significant health effects —any increase in core temperature or activation of thermoregulatory response and the development of areas of localized temperature elevations." He warns, however, that the proposed standard "does not mean that further research is not needed, particularly in the areas of mechanisms and frequency-specific and modulation effects." Cahill did not consider these factors because, "The evidence to support [their existence] is too incomplete at this time to influence exposure guidelines." His proposal is based on the assumption that the public is primarily exposed to continuous wave radiation in the far field. Cahill left EPA in late 1981 to work at Carolina Power and Light's Harris Energy and Environment Center in New Hill, NC. Opinions presented in the paper are Cahill's and are not official EPA policy.

New Standards...The Consumer Product Safety Commission's safety standard for all omnidirectional CB base station antennas went into effect May 24. The regulations were originally scheduled to apply on February 25, but were delayed until Congress' perogative to veto them expired. For details see the June 28 *Federal Register* (48 FR 29682)...Comments are being solicited for a proposed revision of ANSI/IEEE 145-1973: *Definitions of Terms for Antennas*, which covers both transmitting and receiving antennas. A copy of BSR/IEEE 145-1983 is available for \$7 from Ms. M. Lynch, IEEE, 345 East 47th St., New York, NY 10017. Comments are due October 18....The International Electrotechnical Commission's (IEC) Technical Committee 77 on EMC Between Electrical Equipment Including Networks has issued two six-month draft rules: 77(Central Office)20 *Guide to Methods of Measurement of Short Duration Transients on Low Voltage Power and Signal Lines* (\$15) and 77A(Central Office)2 *Supporting and Explanatory Guide to Voltage Fluctuation Limits to Household Appliances* (\$7). These are available pre-paid from the International Sales Dept., ANSI, 1430 Broadway, New York, NY 10018.

VDTs

UK VDT Study...England's Health and Safety Executive (HSE) has published a booklet on VDT worker health and safety. HSE concludes that, "there is no increased risk from radiation emanating from VDUs [visual display units] over and above that which exists already in office workplaces." The document also downplays VDTs as a cause of photo-

sensitive epilepsy and states that it is unclear whether facial rashes are caused by the units. These topics and additional information on radiation issues are covered in the first part of the booklet. Part two offers guidance on human factors involved in VDT use. Recommendations include early planning for introduction of VDTs, close attention to the quality of the screen image, adjustable seating, detachable keyboards and use of document holders. Proper lighting is also emphasized. HSE concludes that these and other ergonomic measures, "can considerably improve the acceptability of the system as well as its overall effectiveness." *Visual Display Units* is available from the Health and Safety Executive, Baynards House, 1 Chepstow Place, London, W2 4TF, England.

Response to NAS...The National Academy of Sciences report that found VDTs safe for workers' vision (see *MWN*, July/August, 1983) was challenged by the head of the Biomedical and Behavior Science Division at NIOSH, which requested the study in 1981. Dr. Barry Johnson disagreed with NAS's suggestion that further research is unnecessary, though he supported the report's basic findings. Johnson put distance between the study and NIOSH, a move some observers believe is intended to help the agency maintain funding of VDT-related work. The NIOSH scientist won praise for his statement in an August 29 editorial in *Computerworld*. In addition, the editorial emphasized the importance of media coverage of the VDT debate: "as long as the question [of VDT health and safety] remains open, we consider it the media's responsibility to cover the issue in full until the final chapter on VDT safety has been written. There is no telling how long that might take." NIOSH's Johnson was not alone in criticizing the NAS report. The Newspaper Guild's President, Charles A. Perlik, Jr., said the report is misleading and its timing unfortunate—coming before the guild's own eye study is completed. Perlik criticized the study's recommendation against mandatory standards for VDTs and VDT workplaces, and protested that the report is likely to be interpreted as finding no health hazards associated with VDTs "and that's not true at all." A representative of the Communications Workers of America (CWA) said the NAS report is a "real cop-out." David LeGrande called the recommendation against research on the possible tie between VDTs and cataracts "irresponsible," and said the report's finding that radiation emissions are less dangerous than ambient radiation is "an oversimplification of a very difficult concept." Copies of the NAS study, *Video Displays, Work and Vision* are available for \$14.50 from the National Academy of Sciences, Room 700, 2101 Constitution Avenue, NW, Washington, DC 20418.

Eyes and Vision...What seems to be distorted color perception after hours of VDT work may be the result of a well-known psychological illusion known as the McCollough effect. A letter to the August 4 *New England Journal of Medicine* explains that one of the authors, an architect at Northwestern University, experienced "an unusual and vivid visual illusion" after several hours of VDT work. "Ordinary white letters and lines on a contrasting back-

ground appear to have a pink color," she and two of her colleagues at the university write. Plain white paper might appear to have a pink tint at its edges. The McCollough effect can last for weeks although it is believed to be harmless. Susan L. Greenwald, and Drs. Mark J. Greenwald and Randolph Blake caution that, "physicians should be aware of the phenomenon so as not to mistake it for a hysterical symptom or a manifestation of neurologic disease."...A study of VDT operators' vision commissioned by a manufacturer of ergonomic office furniture found "no direct relationship between serious temporary or permanent eye pathology and VDT use." Dr. Dennis Arinella, an ophthalmologist at the University of Massachusetts Medical Center at Worcester, studied 21 female VDT operators at Wright Line, Inc. All 21 spent at least 30 hours per week at terminals. Arinella and Lee White, Supervisor of Office Services for the company, conclude that minor, correctable problems do exist, "which appear to increase the incidence of eye strain, including lightly pigmented irises, minimal uncorrected refractive errors, mild muscle imbalance and decreased tear production." The study will be presented October 12 at the meeting of the Office Automation Management Association in Washington, DC....The American Optometric Association (AOA) has published *Vision and the VDT Operator*, a brochure offering "advice on how to make VDT work easier on the eyes." The AOA warns that "VDT use can aggravate moderate and more severe vision problems," and recommends a safety checklist to protect terminal user vision. The list includes annual eye examinations, lighting and glare control and 15-minute breaks every two hours.

Some Statistics...Color terminals are rapidly gaining popularity due to falling prices and a growing supply of color-utilizing software, according to a special report prepared for *Computerworld*. Color terminals can cost less than \$1,300, compared to more than \$10,000 only a short time ago, reports John Witherow in the August 29 issue. Color terminals are likely to replace or complement standard VDTs in many offices, Witherow says. The report notes that, "users working on color terminals reported fewer instances of eye strain as compared to those working on conventional CRTs."...The number of VDT office workstations is expected to increase almost 700 percent, from 3 million currently to more than 20 million by 1992 according to a report on office automation produced by an independent market research organization. *Office Automation Systems Market in the US*, Report No. A1092, is available for \$1,275 from Frost & Sullivan, Inc., 106 Fulton Street, New York, NY 10038.

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FROM THE FIELD

Letter from the Soviet Union

Professor Mikhael G. Shandala of the A.N. Marzeev Institute of General and Communal Hygiene in Kiev visited the US last June (see story p.4). Before he left, he sent Microwave News the following notes on radiofrequency and microwave radiation standard setting in the Soviet Union.

We thank Christopher Dodge of the Congressional Research Service's Science Policy Research Division at the Library of Congress in Washington, DC, for translating Dr. Shandala's letter.

The basic objective of investigations into the biological and health effects of electromagnetic fields (EMFs) in the USSR is to set safety standards on the basis of sound science. Studies are designed to determine the dose dependency of a number of reported biological responses to EMFs. Dose response data are then applied to realistic radiation exposure scenarios. Experience from occupational histories is one route taken to establish exposure standards for the general population, also taking into consideration younger people, pregnant women and the elderly.

The observation of a new biological response to EMFs is not necessarily construed to mean that it is deleterious in nature. The nature of the response must be evaluated in terms of its significance to the entire organism. We distinguish two responses: adaptive and compensatory. Compensatory responses, characterized by functional stresses over a prolonged period of time, can lead to negative consequences for the organism. Accordingly, occupational exposure standards, involving relatively circumscribed daily times of exposure to EMFs over long periods of time, are based on compensatory responses. On the other hand, adaptive responses (threshold effects) are taken into account in establishing exposure standards for the general population.

Together with the above principles, we also use a number of methodological concepts which include the following:

- Risk-benefit analysis (with emphasis on biomedical data as opposed to economic issues).
- Re-evaluation of present standards and preventive measures.
- Evaluation of basic biological interactions with other physical and chemical factors in the environment.
- Consideration of the entire organism in its natural, domestic and occupational settings.
- Maximum permissible limits of exposure to chemical and physical factors as a function of the parameters of exposure (e.g. frequency, duration, intensity, etc.).
- Thresholds of responses to physical and chemical factors.
- Delayed effects of physical and chemical factors.
- Exposure standards evaluated (peer-review), refined, promulgated and enforced.

Professor Mikhael G. Shandala

A.N. Marzeev Research Institute of General and Communal Hygiene, Ministry of Health of Ukrainian SSR, Kiev, USSR.

SHORT COURSES

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

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

October 17-18: EMI Workshop, Philadelphia, PA. Fee: \$575. Contact: R&B Enterprises, 20 Clipper Road, W. Coshohocken, PA 19428, (215) 825-1960. Repeated • December 5-6.

October 17-21: Communications Satellite Engineering, Washington, DC. Fee: \$855. Contact: Continuing Engineering Education, George Washington University (GWU), Washington, DC 20052, (800) 424-9773.

October 18-21: Electromagnetic Compatibility Engineering, San Mateo, CA. Fee: \$900. Contact: Center for Professional Advancement, PO Box 964, East Brunswick, NJ 08816, (201) 249-1400.

October 19-21: Fundamental EMI Control Design and Tests, Philadelphia, PA. Fee: \$695. Contact: R&B, see October 17 above. Repeated • October 26-28: Boston, MA.

October 22: Physics and Engineering of NMR Imaging, San Francisco, CA. Fee: \$85 (IEEE members), \$105 (others). Contact: Paul Phelps, Lawrence Livermore National Laboratory, PO Box 5504, L-156, Livermore, CA 94550, (415) 422-8312.

October 24: EMI Control: Emission & Immunity, Oak Brook, IL. Fee: \$85. Held at the *National Communications Forum*. Contact: NCF, Suite 4808, 505 N. Lake Shore Drive, Chicago, IL 60611, (312) 828-0491.

October 24-25: EMC Laboratory Experience Workshop, Mariposa, CA. Fee: \$695. Contact: EMXX, see October 11 above.

October 24-28: Antennas and Arrays, Washington, DC. Fee: \$855. Contact: GWU, see October 17 above.

October 25-28: Grounding and Shielding, Sunnyvale, CA. Fee: \$815. Contact: Don White Consultants, Inc. (DWCI), State Route 625, PO Box D, Gainesville, VA 22065, (703) 347-0030. Repeated • November 1-4: Philadelphia, PA; • January 24-27: Phoenix, AZ.

October 25-28: Millimeter Wave Radar, Washington, DC. Fee: \$780. Contact: GWU, see October 17 above.

November 1-3: An Introduction to EMI/RFI/EMC, Los Angeles, CA. Fee: \$815. Contact: DWCI, see October 25 above.

November 1-4: Advanced Radar Concepts, Rockville, MD. Fee: \$720. Contact: Linda Billard, Technology Service Corp., 8555 16th St., Suite 300, Silver Spring, MD 20910, (800) 638-2628.

November 4-18: Microwave and High-Speed Digital Integrated Circuits Manufacturing and Applications, Tokyo, Japan. Fee: \$4,955. Contact: Kazuo Moro, Technology Transfer Institute, 624 S. Grand Ave., Suite 2407, Los Angeles, CA 90017, (213) 628-9381.

November 7-11: Synthetic Array and Imaging Radars, Los Angeles, CA. Fee: \$875. Contact: Short Course Program Office, UCLA Extension, PO Box 24901, Los Angeles, CA 90024, (213) 825-1295.

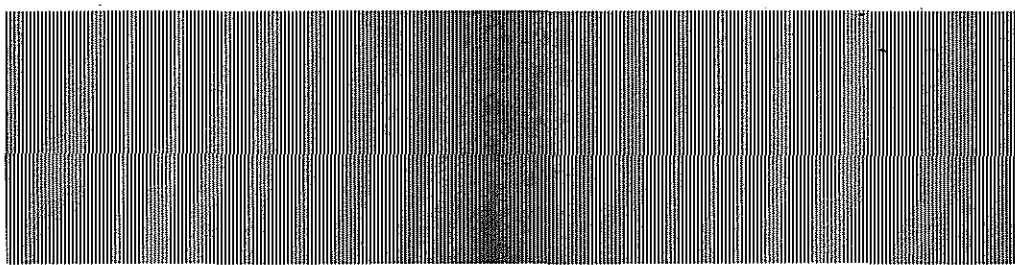
November 11: Product Safety Seminar: National and International Aspects, San Francisco, CA. Fee: \$275. Contact: EMXX, see October 11 above.

November 14-18: Protection Against MW/RF Radiations, Electric and Magnetic Fields, Ispra, Italy. Fee: 350,000 Lira. Contact: Secretariat ISPRA Courses, Centro Comune di Ricerca, 21020 ISPRA (Varese), Italy, (0332) 781128.

November 14-18: Principles of Modern Radar, Atlanta, GA. Fee: NA. Contact: Department of Continuing Education, Georgia Institute of Technology (GIT), Atlanta, GA 30332, (404) 894-2547.

November 15-25: Biological Effects and Dosimetry of Non-Ionizing Radiation: Static and ELF Electromagnetic Fields, Erice, Italy. Fee: NA. Contact: Professor Martino Grandolfo, Istituto Superiore di Sanita, Viale Regina Elena, 299, 00161 Rome, Italy.

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

VDT Radiation: Focus on Flyback Pulses

A number of experts now speculate that radiation emissions from video display terminals (VDTs) might be associated with biological effects. Their concern stems from new measurements showing that magnetic field pulses from flyback transformers are similar in shape and intensity to those which can alter the development of chick embryos.

In numerous interviews, researchers and regulators told *Microwave News* that they are aware of Dr. Jose Delgado's experiments — demonstrating that pulsed magnetic fields can be biologically active at extremely low levels — and their implications for the VDT safety debate. No connection between VDT emissions and health problems has been established, however, and none of the experts contacted has suggested that VDT pulsed radiation is associated with the 11 reported clusters of problem pregnancies among VDT operators.

Indeed, many investigators are still skeptical that the Delgado experiments are reproducible. In Sweden, however, Dr. Kjell Hansson Mild's partial replication is prompting new government research on the reproductive hazards associated with VDTs.

Though VDT workers have long been apprehensive about radiation hazards, government and industry experts have steadfastly maintained that the emission levels are too low to be harmful.

The Food and Drug Administration (FDA) is planning to issue a revised policy statement on VDTs in the next few weeks. In it, the agency will discuss the accumulating data on the bioeffects of low-frequency, low-intensity magnetic fields, though it is unlikely that the FDA will significantly change its position on VDT radiation.

The Pulse Waveform

Dr. Arthur Guy, director of the Bioelectromagnetics Research Laboratory at the University of Washington's School of Medicine in Seattle, told *Microwave News* that the intensity of the current induced by VDT magnetic fields is "about the same" as that which was induced in Delgado's experiments. Guy added that the VDT's magnetic field pulse shape is similar to the signal used by Electro-Biology, Inc. (EBI) to heal bone fractures, though the internal currents induced by the EBI coil are much stronger.

Richard Tell, a physicist with the Environmental Protection Agency (EPA), said that the similarities in shape and intensity between VDT pulses and those used by Delgado should be studied closely. Tell compared the time rates of change of VDT magnetic fields to those of the magnetic fields used by Delgado and found them to be of the same order of magnitude. Thus, according to Tell, the possibility of bioeffects cannot be ruled out.

Last year, Delgado and his associates at the Centro Ramon y Cajal Hospital in Madrid, Spain, concluded that pulse shape may be the "decisive parameter" for determining whether pulsed magnetic fields affect the development of chick embryos (see *MWN*, March and November

(continued on p.10)

ELF Bioeffects Studies at BEMS

Extremely low frequency (ELF) radiation emerged as one of the most exciting topics at this year's meeting of the Bioelectromagnetics Society (BEMS) held in Atlanta, GA, in mid-July. Summarized below are the reports from three research groups whose results are particularly noteworthy.

Blackman and the Earth's Magnetic Field

Dr. Carl Blackman's paper was the most provocative of the conference — it provides evidence that the location of frequency windows for calcium efflux from brain tissue is dependent on the Earth's magnetic field. Blackman can now predict which frequencies induce calcium efflux as a function of the *net* static magnetic field.

At the 1982 BEMS meeting, Blackman reported that he had observed calcium efflux at odd multiples of 15 Hz — with no effect at 30 Hz. This year, he said that he could induce efflux at 30 Hz if he doubled the net static magnetic field. Thus, the original discovery of efflux by Drs. Ross Adey and Suzanne Bawin at 15 Hz would shift to 30 Hz, if the Earth's magnetic field were twice as strong.

In the course of his talk, Blackman linked the calcium work to Dr. Jose Delgado's experiments on the effects of extremely weak, pulsed magnetic fields and to Dr. Cyril Smith's work on the influence of magnetic resonance in the Earth's magnetic field.

The new theory is not complete and was described as a "work in progress." Blackman said that he is still unsure whether the underlying physical mechanism for his observations is related to the electric or to the magnetic field. If it is the electric field, he thinks a cyclotron resonance-like phenomenon may be at work. (Cyclotron resonance results from the acceleration of an electric charge in a static magnetic field.) Otherwise, Blackman believes he might be observing a magnetic resonance effect.

Whatever the mechanism, Blackman said that the implications are clear: researchers must measure the intensity and orientation of the steady state magnetic field at the sample during the course of a given experiment. He suggested that past failures to replicate weak field interactions may have been due to variations in the magnetic field vector.

"This could explain the problem of an effect that comes and goes depending on the immediate environment," he explained in an interview with *Microwave News*. Blackman is with the Environmental Protection Agency in Research Triangle Park, NC.

Blackman's work supports the increasingly popular hypothesis that the Earth's magnetic field plays a decisive role in causing the weak field interactions discovered by Delgado. Some researchers have been unable to duplicate Delgado's experiments (see *MWN*, March 1983 and June 1984), in which low intensity magnetic fields caused gross alterations in developing chick embryos.

Smith and his colleagues at the University of Salford in England have shown that there are observable changes in dielectric permittivity and loss in biological systems under conditions of magnetic resonance in the Earth's natural field

(see *MWN*, October 1983). Blackman has now extended Smith's work to a much more complex system, calcium efflux.

Blackman presented his paper on the opening night of the BEMS meeting at a symposium on magnetic fields and biological systems. Later that evening, Dr. Carl Durney of the University of Utah in Salt Lake City commented that a back-of-an-envelope calculation indicated that the Earth's magnetic field would not be an important variable: the energy of a proton in the Earth's field is nine orders of magnitude (a billion times) smaller than that of thermal interactions (kT) at room temperature, he said.

Nevertheless, Durney was not willing to dismiss Blackman's (or Smith's) findings. In an interview, he said that he found them "puzzling and exciting" and that they could help us better understand basic mechanisms.

Dr. Alwyn Scott of Los Alamos National Lab in New Mexico observed that the apparent difference in magnitude may not be as great as it first seems if the biological system has a way of storing energy from the Earth's magnetic field.

Winters's Tumor Cells

Later in the conference, Dr. Wendell Winters presented details of the experiments he is running with Dr. Jerry Phillips which show ELF radiation can greatly enhance the proliferation of human tumor cells. These results have generated a great deal of interest since first reported at a New York State Power Line Project Panel meeting in March (see *MWN*, April 1984). Winters described this effect as "permanent" because he observed it two to three weeks after the field was turned off.

By the time he came to BEMS, Winters had completed 16 sets of experiments with three different tumor cell types (colon, breast and head/neck). In each case he found the greatest enhancement in growth rate, as measured by the proliferation of cell colonies, when the tumor cells were exposed to electric and magnetic fields together or magnetic fields alone.

Winters reported that in ten experiments in which human colon cancer cells were exposed for 24 hours to an electric field of 300 mA/m² (rms) and a magnetic field of 1 gauss, the cells formed 5.6 times more colonies than controls. For magnetic fields alone, the proliferation rate was 5.2 times greater than controls, while for the electric field alone it was only 1.8 times greater. Similar though less pronounced effects were observed with breast and head/neck tumor cells: according to Winters, the growth rates in combined fields and in magnetic fields were statistically significant.

Winters, a cell biologist at the University of Texas Health Science Center in San Antonio, TX, also reported on an experiment with colon cells exposed to a 0.5 gauss magnetic field. The increase in tumor-associated cell surface antigens at 300 mA/m² and 0.5 gauss was smaller than the observed increase at 300 mA/m² and 1 gauss, though both were larger than the response of control cells.

After Winters's paper there were numerous hallway dis-

cussions on the possible connection between his *in vitro* exposures of cell cultures to 60 Hz electromagnetic fields and the many reports of leukemia among workers and the general population exposed to 50 and 60 Hz fields from power lines. The informal consensus was that it is still too early for any conclusions but that much attention will be devoted to Winters's and Phillips's newly observed effect in the future.

Navy's Second Monkey Study

Dr. W. Gregory Lotz and Jack Saxton of the Naval Aerospace Medical Research Lab in Pensacola, FL, presented the preliminary findings of their replication study on the effects of chronic ELF exposure of young rhesus monkeys. Although they reported a significant increase in the growth rate of exposed males, confirming previous results, subsequent statistical analysis performed after the BEMS meeting did not support this conclusion. In early September, Lotz told *Microwave News* that an overall analysis of variance indicated that the change of growth rate is not significant at the 0.05 level.

At about two-and-a-half years of age, the male monkeys exposed from the age of one month began to gain weight faster than those in the control group. Divergence continued for about a year, at which time the difference in size

stabilized. In the last six months of the 54-month exposure protocol, the divergence narrowed. The researchers also identified a trend toward higher testosterone levels among the exposed males as compared to controls.

The 30 monkeys (17 male and 13 female) were exposed to an electric field of 20 V/m and a magnetic field of 2 gauss at frequencies randomly modulated between 72 and 80 Hz.

At the meeting, Saxton and Lotz offered three hypotheses for their observations. First, ELF radiation causes a generalized growth effect; second, the neuroendocrine system is affected; and third, ELF stimulates the testes. They reject the first hypothesis because the growth effect did not occur in young females, and they are leaning away from the testes effect. While the exposures have now ended, the data analysis continues, particularly the results from the neuroendocrine end points.

Lotz said that he was planning to present a more complete picture of their results at the *23rd Hanford Life Sciences Symposium: Interaction on Biological Systems with Static and ELF Electric and Magnetic Fields*, in Richland, WA in early October.

According to Lotz, the Navy is not planning to continue its ELF studies at the Pensacola lab in the fiscal year beginning October 1. Instead Lotz and co-workers will turn their attention to biological interactions at higher frequencies.

Future Unclear for EPA RF/MW Guidance

The future of the Environmental Protection Agency's (EPA) radiofrequency and microwave (RF/MW) radiation exposure guidance became more uncertain last month with the ouster of Glen Sjoblom as director of the Office of Radiation Programs (ORP). ORP handles both ionizing and non-ionizing radiation, and the reason or reasons for the shake-up are unknown. Sources following developments at EPA have noted, however, that Sjoblom was the highest ranking official to support proposing RF/MW exposure limits. Sjoblom now oversees international activities for the Office of Air and Radiation.

As the agency debates whether to scrap the guidance it has spent years developing, the Federal Communications Commission (FCC) plans to act on its proposed rule making on RF/MW safety this fall.

The new director of ORP, Sheldon Meyers, told *Microwave News*, that EPA has no firm schedule for deciding whether to propose general population exposure limits. Meyers said the agency is still reviewing the options laid out in a memorandum from Deputy Assistant Administrator Jack Campbell — options which range from shelving the guidance to proposing a limit of 100 $\mu\text{W}/\text{cm}^2$ at resonant frequencies (see *MWN*, July/August 1984).

EPA Administrator William Ruckelshaus received his first briefing on the guidance September 4, three months after the proposal was scheduled for publication. The proposed rules were completed on time but met stiff opposition

from the Office of Policy Planning and Evaluation as soon as internal review began this spring.

The agency has held a series of internal meetings on the guidance this summer and has also received input from the Electromagnetic Energy Policy Alliance (EEPA), a new industry lobbying group. Alliance representatives met with EPA's John Topping, David Janes and Sheldon Meyers on August 30 to express support for federal limits based on the 1982 ANSI guidelines.

Meanwhile, the FCC's Dr. Robert Cleveland reports that "we are moving independently from EPA and hope to consider our rule making at the commission's November 8 meeting." The proposal to extend the FCC's responsibility to include non-ionizing radiation hazards under the National Environmental Policy Act was released on January 28, 1982 (see *MWN*, March and September 1982).

Meyers, an engineer, formerly served as the Deputy Assistant Administrator for Air and Radiation. Meyers has also held a number of other EPA posts, working on solid and nuclear waste issues as well as air quality standards.

NAS Uncertain About EMP Effects

Some electronic systems may be susceptible to electromagnetic pulse (EMP) radiation, according to a study committee of the National Academy of Sciences (NAS). In a report released on August 8, the committee concluded that electronic systems can be protected from a high altitude

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nuclear blast, but that the degree of vulnerability is difficult to estimate.

The NAS committee, chaired by Caltech's Dr. John Pierce, "strongly favored" shielding electronic equipment from EMP by placing subsystems in specially-designed copper lined buildings or metallic boxes, commonly known as Faraday cages, which electromagnetic waves cannot penetrate. It was "skeptical" about "tailored hardening" (in which components are individually shielded) because of some unpredicted failures.

No reliable test data on EMP vulnerability are available because atmospheric testing of nuclear weapons was banned in 1963. To gather needed information, the Navy is planning to build an EMP simulator called EMPRESS II in the Chesapeake Bay (see *MWN*, July/August 1984).

The NAS committee concluded that because "there is no way to base an analytical estimate of EMP vulnerability on first principles, there can be no substitute for the best physical simulations possible." It did not specifically endorse EMPRESS II, however. According to Dr. John Richardson, the principal NAS staff officer on the study, EMPRESS II was not an issue during the committee deliberations.

The study was requested by the Defense Nuclear Agency. Copies of *Evaluation of Methodologies for Estimating Vulnerability to Electromagnetic Pulse Effects* are available free from the Energy Engineering Board, NAS, 2101 Constitution Ave., NW, Washington, DC 20418.

The committee's recommendations on the engineering and statistical aspects of building EMP-resistant military systems are reprinted below.

Recommendations

Engineering Aspects

- There should be a continued reappraisal of the threat, its consequences, and the best near-term practices and longer-term research needed for meeting it.
- Adequate analyses should be made of what systems, subsystems and support systems are essential to completion of mission.
- There should be great emphasis on achieving assessability by promptly developing better and cheaper means for virtually complete and effective shielding of systems essential to the completion of mission. This objective should include a strong emphasis on early use of standardized shielded boxes interconnected with optical fibers.
- There should be a program to study and devise and evaluate the best and most economical way for continual testing to assure the maintenance of hardness.
- There should be a better understanding of the mechanisms of component failure and better and more insightful component tests and interpretation of test data.
- There should be increased emphasis on thoroughgoing analysis, testing and comparison of analysis with test at the level of functional circuit aggregations, or "boxes."
- A long-range program should be initiated and directed toward the systematic validation of prediction methods. The TRESTLE and comparable high-level simulators constitute a promising avenue to that end. These simulators generate pulses that are similar in many ways to, but also significantly different from, the expected EMP event. Important insights into the credibility of prediction methods themselves could be obtained by employing these methods to predict the response of components and systems to the fields

known to be produced by the simulators and by confirming those predictions with experiments using the simulators.

Statistical Aspects

- The EMP community, including its management, should be better educated on the key ideas and procedures of statistics and reliability. Improved standardization of statistical terminology used by the EMP community should be pursued in order to reduce confusion with respect to its interpretation and uses.
- The government should utilize qualified and experienced personnel, well trained in statistics, to oversee contractors' bids and work that involve statistics.
- Collaboration among statisticians, engineers and physicists working in the field of EMP protection and assessment should be encouraged. The statisticians on such teams should be well versed in the latest techniques and developments in statistical methodologies and reliability.
- Contractual specifications that may be interpreted to require survival with probability equal to one (that is, certainty) should be avoided. Such specifications can lead to misunderstanding and legal problems, as well as to a poor choice of contractors. We recommend, rather, a collection of tests such that passing all will be acceptable as satisfaction of EMP requirements.
- Because fault tree analysis is a useful management tool, it should be utilized in EMP work where it is applicable. Both empirical and theoretical work may be required to tailor fault trees to the particular needs of the EMP problem.
- The Defense Nuclear Agency should establish a number of post-doctoral fellowships closely integrated with the field of EMP protection and assessment. The fellowships could be administered so as to encourage interdisciplinary collaboration, attract new talent to the field, and supplement the ongoing programs.

Seatbelts On, Cigarettes Out and Computers Off?

The chairman of a panel examining the risks of electromagnetic interference (EMI) to aircraft communication and navigation systems has suggested that airlines bar the use of portable electronic devices during takeoffs and landings.

In a memorandum to members of the Radio Technical Commission for Aeronautics' (RTCA) Special Committee 156 on possible EMI to aircraft electronics, Committee Chairman Frank White wrote: "It would, in my view, be logical to prohibit the use of passenger-operated electronic devices during takeoffs and landings when seatbelts were on, tray tops closed and seat backs vertical. This would affect passenger use of portable devices for perhaps 10-15 minutes of time...These are times when navigation and communication are the most critical to flight safety." (See also *MWN*, October 1983, April and June 1984).

White is not convinced that an EMI-related safety problem really exists, arguing in his memo to the committee that, "If we could find just one device that could be carried into an aircraft and cause interference we would have a case to build on." White also argued that it is not worth revising RTCA's 1963 Report DO-119, *Interference to Aircraft Electronic Equipment from Devices Carried Aboard*, because the emission limits proposed there have been "almost totally ignored." The limits later proposed by the Federal

Communications Commission (FCC) were unrelated to the RTCA work.

White suggested that the FCC afford greater protection to that portion of the spectrum used by aircraft. Those bands include: 10-25 kHz (Omega), 100-1750 kHz (ADF), 108-137 MHz (VOR/ILS/VHF), 329-335 MHz (glide scope) and public telephone band(s) above 400 MHz. He also raised the possibility of protecting the 2-30 MHz band. White proposed adding 10 dB or more to the present FCC limits — the exact value would be chosen after careful study.

White's memo was distributed on July 24, after the committee's last meeting on June 12-13, and his proposals will be taken up at its September 18-19 meeting.

Among the key decisions reached by the committee at its June meeting are:

- An incident file on all cases of aircraft-related EMI will be set up.
- More testing should be done in the Omega band.
- Acceptable path data can be generated without having to fly an aircraft.
- The aircraft fuselage cannot be relied upon to provide sufficient shielding of airborne receivers from RF levels allowed from FCC class B devices.
- While measurement data indicate that class B devices can be used without causing EMI, there may be some variation among different aircraft.

In addition, David Hantulla, formerly with Apple Computer and now an independent EMI consultant, observed that the interference reports received to date indicate that radios and cassette players were greater sources of EMI than computers. He argued that the committee should start classifying devices according to their EMI potential.

At its September meeting, the committee will look at the inverse problem: the possibility that an aircraft's high frequency (HF) transmissions could interfere with a passenger's electronic device.

Project ELF Study Continues Despite Court Ruling

Committee selection for the American Institute of Biological Sciences' (AIBS) literature review on extremely low frequency (ELF) radiation bioeffects is in its final stages, with experts in seven out of eight topic areas on board. As of early September, however, AIBS had yet to pin down who will write summary research papers for the study, despite the October 31 due date for a preliminary draft report.

The Navy's \$319,000 contract with AIBS for an analysis of the post-1977 literature was to be part of a court-ordered supplemental environmental impact statement (SEIS) for Project ELF, a land-to-submarine communications system now under construction in Wisconsin and Michigan (see *MWN*, July/August 1984). Although AIBS will complete its study, the court order was overturned in August, and it is now unclear whether the Navy will file a SEIS.

The AIBS report committee is chaired by Dr. H.B. Graves of Pennsylvania State University. The other mem-

bers, and their topic areas are: Dr. Ralph Smialowicz, hematopoietic and immune systems; Dr. Asher Sheppard, cellular and in vitro systems; Dr. Neil Chernoff, growth/reproduction/development; Dr. David Savitz, human studies; Dr. Robert Lindberg, environmental biology; Dr. Thomas Tenforde, magnetic studies; and Dr. Lionel Jaffee, bone growth and fracture repair.

As we go to press, an expert on physiology/neuroendocrine systems has yet to be chosen, and AIBS Project Director Don Beem said it is possible that this slot will be eliminated and the material handled by other members.

The committee's work will be reviewed by an advisory group composed of private consultants Fred Dietrich and Dr. William Wisecup and Battelle's William Kaune and Dr. Richard Phillips.

The summary research papers on specific ELF bioeffects areas, along with material from a literature search being conducted by IIT Research Institute in Chicago, are key elements in the AIBS review. Although AIBS seems confident that it will enlist a strong field of contributors, at least one researcher who was asked to participate is dissatisfied with the composition of the report committee and its advisory group. In a strongly worded letter to Beem, Dr. Robert Becker backed out of writing the paper on bone growth, challenging the objectivity of a number of study participants.

Wisconsin Drops Suit

On August 20, the Seventh Circuit Court of Appeals in Chicago overturned a lower court order requiring a SEIS for the Project ELF system. The 43-page decision (*Wisconsin v. Weinberger*, 84-1569) from Judges Cummings, Wood and Cudahy included a partial dissent from Cudahy, who believes a new EIS is needed.

The majority opinion concluded that the information provided by the State of Wisconsin and Marquette County, Michigan, the plaintiffs, "falls short of the threshold of 'significance' at which the duty to prepare a SEIS is triggered." Judges Cummings and Wood reasoned that: "Were we to require the Navy formally to reassess its proposed action with a SEIS every time some bit of new information appeared, we would be unjustifiably interfering with the Navy's mission."

Further, they noted that: "The Soviet Union allegedly is already advanced in this low frequency submarine communications technique. The district court gave no consideration to these serious circumstances."

Judge Cudahy, on the other hand, found that district court Judge Crabb "reviewed an extensive administrative record and heard testimony concerning controversial scientific research, and her conclusions from that evidence are precise and sound." Cudahy concluded that the public scrutiny accompanying the SEIS process "is the best available means for ensuring the Navy does indeed give the new information full consideration."

In a June 13 order, the appeals court suspended the district court's injunction against further construction on the project (see *MWN*, July/August 1984).

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As a final blow to Project ELF opponents, Wisconsin and Marquette County lost their bid to have the U.S. Supreme Court reinstate the construction ban. On August 17, shortly before the appeals court issued its decision, Justice John Paul Stevens denied their petition without comment.

Study Discounts Vernon, NJ Birth Defect Fears

A recently completed study of birth defects in the town of Vernon, NJ, found no evidence to support local fears that ambient radiofrequency and microwave (RF/MW) radiation in the community is a health hazard. The long-awaited report from the New Jersey State Department of Health has been sharply criticized by the community group which requested the investigation, however, and is unlikely to quiet community opposition to new RF/MW sources.

A health department team led by Dr. George Halpin reported that the incidence of birth defects in Vernon Township (34.5 per 1000 pregnancies) "was not statistically different from the rate observed in the rest of Sussex County (32.2 per 1000 pregnancies)." The study covered live births and fetal deaths occurring in the county after twenty weeks of pregnancy from 1975 through 1981, a period encompassing the startup of the first satellite communications station in Vernon. The town now has three major satcom stations (see *MWN*, November 1982).

In an interview with *Microwave News*, Halpin, the director of the department's Division of Parental and Child Health, said he was confident that the study "was sufficiently powerful to detect whether something is going on."

Citizens Against the Tower (CAT), a group of Vernon residents opposing new broadcast facilities, disagrees. Ac-

cording to CAT spokeswoman Elise Kreindler, the study was too general to address the community's chief concern: potential clusters of birth defects in several Vernon neighborhoods, including an area close to RCA Americom's satcom station.

Members of CAT also believe that the study failed to pick up many birth defect cases. For example, Kreindler said she has documented six cases of Down's syndrome within the "cluster" areas of Vernon while the Department of Health only turned up three. Finding the report "wholly inadequate," Kreindler said the group will seek independent analysis of the study data to prove its case.

No specific type of defect occurred at a higher rate in Vernon than in the county, but the report states that "the difference in the incidence of chromosomal anomalies between the two areas approached statistical significance." Four of the eight reported cases of defects resulting from chromosomal abnormalities were in Vernon.

Halpin believes the only potentially important factor left uncovered is ambient radiation levels. The state, lacking measuring equipment of its own, had asked the Environmental Protection Agency to perform a survey of the county but was turned down. As a result, the report states that "at no time did this study attempt to answer any question as to the etiology or causation of any of the defects identified," although it did determine that the incidence of defects in Vernon was within the expected range.

Investigators reviewed hospital records for 86.5 percent of the 1632 births in Vernon and 94.4 percent of the births in the rest of the county.

For more information, contact Tom Hagy, New Jersey Department of Health, CN360, Trenton, NJ 08625, (609) 984-7160.

SHORT COURSES

October 15: **EMI Susceptibility Guidelines for Computing Devices**, Boston, MA. Fee: \$295. Contact: Greg Gore, R&B Enterprises, 20 Clipper Rd., West Conshohocken, PA 19428, (215) 825-1965. **Repeated** November 7: Philadelphia, PA.

October 15-18: **Fundamentals of Numerical Solution Methods in Electromagnetics**, Oxford, MS. Fee: \$550. Contact: Division of Continuing Education, University of Mississippi, University, MS 38677.

October 16-17: **Magnetic Analysis Program**, Milwaukee, WI. Fee: \$495. Contact: A.O. Smith Engineering Systems, 8901 N. Kildeer Court, Milwaukee, WI 53209, (800) 558-6980, ext. 2860. **Repeated** November 13-14; December 11-12.

October 16-19: **Electronic Warfare**, Bethesda, MD. Fee: \$730. Contact: Linda Billard, TSC, 962 Wayne Ave., Suite 600, Silver Spring, MD 20910, (800) 638-2628, or (301) 565-2970 in MD.

October 20: **Microwave Cooking**, Troy, MI. Fee: \$35-45. Contact: International Microwave Power Institute, 301 Maple Ave. West, Vienna, VA 22180, (703) 281-1515.

October 22-26: **Antennas and Arrays**, Washington, DC. Fee: \$875. Contact: Continuing Engineering Education, George Washington University (GWU), Washington, DC 20052, (800) 424-9773, or (202) 676-6106 in DC.

October 22-26: **Radiowave Propagation for Communications Systems Design**, Washington, DC. Fee: \$875. Contact: GWU, see October 22 above.

October 23-25: **Introduction to EMI/RFI/EMC**, Washington, DC. Fee: \$815. Contact: Don White Consultants, Inc. (DWCI), State Route 625, PO Box D, Gainesville, VA 22065, (703) 347-0030.

October 23-26: **Grounding & Shielding**, Atlanta, GA. Fee: \$815. Optional fourth day for \$235. Contact: DWCI, see October 23 above. **Repeated** November 13-16: Sunnyvale, CA; December 4-7: New York, NY.

October 24-25: **Seminar on Frequency Measurements**, Boulder, CO. Fee: \$400. Contact: Mike Lombardi, Division 524, National Bureau of Standards, Boulder, CO 80303, (303) 497-3212.

October 29-November 2: **Electromagnetic Interference and Control**, Washington, DC. Fee: \$875. Contact: GWU, see October 22 above.

October 31-November 1: **EEPA Seminar**, Chicago, IL. Fee: \$250 (members), \$275 (others). Contact: Richard Ekfelt, Electromagnetic Energy Policy Alliance, 1800 M St., NW, Washington, DC 20036, (202) 452-1070.

November 5-8: **Millimeter-Wave Engineering and Applications**, Washington, DC. Fee: \$795. Contact: GWU, see October 22 above.

November 5-15: **Bioelectrochemistry II: Membrane Phenomena**, Erice, Italy. Fee: \$500. Contact: Dr. M. Blank, College of Physicians & Surgeons, 630 West 168th St., New York, NY 10032.

BIOLOGICAL EFFECTS

Special Issues...The latest issue of the *Journal of Bioelectricity* (Vol. 3, No. 1&2, 1984) is a special symposium issue: it features seven papers on "Mechanisms of Bioelectrical Growth and Repair" edited by Dr. Betty Siskin of the Wenner Gren Research Lab at the University of Kentucky in Lexington, and eight papers presented at the *1st Annual Meeting of the International Society for Bioelectricity*, held in Boston, MA, last October 1, edited by the journal's editor Dr. Andrew Marino of the Department of Orthopaedic Surgery at Louisiana State University Medical Center in Shreveport. In addition, the volume contains seven regular papers. The journal is published by Marcel Dekker, Inc., 270 Madison Ave., New York, NY 10016....The August 1984 *IEEE Transactions on Microwave Theory and Techniques* is a special issue devoted to "Electromagnetic Wave Interactions with Biological Systems." The issue, edited by Dr. James Toler of Georgia Tech in Atlanta, features two dozen papers on dosimetry, bioeffects, measurements, imaging and hyperthermia. A copy is available for \$6.00 (IEEE members) or \$12.00 (non-members) from IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854.

Annotated Bibliographies...Dr. J. Patrick Reilly of Johns Hopkins University's Applied Physics Lab has completed the fourth edition of *Human Reactions to ELF Electric and Magnetic Fields - An Annotated Bibliography of Current Literature*, (No. PPSE T-30; June 1984). A limited number of copies are available from Reilly at JHU-APL, Johns Hopkins Road, Laurel, MD 20707....The Air Force School of Aerospace Medicine has issued two new volumes in its series, *USAFSAM Review and Analysis of Radiofrequency Radiation Bioeffects Literature*. The first two reports were released in 1982 (see *MWN*, July/August 1982) and a fifth is expected before the end of the year. The five volumes will contain analyses of about 200 papers selected from over 1,000. Each citation includes an abstract and a "critique" written by Louis Heynick and Dr. Peter Polson of SRI International in which the paper is evaluated with respect to the methodology, validity and significance of the reported findings. Copies of the reports are available from the National Technical Information Service (NTIS), Springfield, VA 22161. (The third report is No. USAFSAM-TR-84-6, March 1984, NTIS No. AD A111190; the fourth is No. USAFSAM-TR-84-17, May 1984, NTIS No. AD A116139)....Vol. VIII, No. 2 of *Biological Effects of Non-Ionizing Electromagnetic Radiation* (January 1984) has been published by the Office of Naval Research. A limited number of copies are available from ONR, Code 441, 800 N. Quincy St., Arlington, VA 22217. Be sure to include a self-addressed mailing label.

COMPATIBILITY & INTERFERENCE

FCC Computer RFI Rules...On July 30, the FCC denied a petition filed by Glen Dash of Dash, Straus & Goodhue, Inc. in Boxborough, MA, requesting changes in the commission's measurement procedures for radiated emissions

from computing devices. Soon after the FCC issued new test procedures (commonly known as MP-4) last summer (see *MWN*, September 1983), Dash asked for some additional revisions. Dash, who is both an engineer and a lawyer, wanted a testing requirement specifying that all interface cables be left unterminated — MP-4 requires that peripherals be connected to the host computer via interface cables. The FCC rejected this option, arguing that "it is more important to simulate the conditions of actual use..." and that it was too soon to make such a "major shift in measurement philosophy." Other proposals made by Dash on the positioning of the cables during testing were also rejected by the commission. CBEMA had opposed the Dash petition. In a telephone interview, Dash said that his petition was "nothing more than a suggestion to streamline the testing procedure." He went on to call the MP-4 revisions a "tremendous leap forward" and said his petition was simply "asking the commission to go one step further." In retrospect he added, "I should have simply written the FCC a letter."...Responding to another petition on the same day, the FCC denied CBS Inc. an exemption from the commission's computer rules (Part 15, Subpart J) for electronic and pipe organs used primarily by churches. The organs use digital electronics for tone generation and for the operation of the console in controlling such variables as volume. (Though CBS is best known as a broadcaster, it also is in the organ business.) The FCC noted that CBS did not submit any measurement data to support its case for an exemption and decided that there was no justification for the exemption, especially given what it called the "minimal" requirements of its *verification* rules. The FCC concluded: "We believe that it is important for manufacturers to be made aware that digital electronic circuitry is capable of emitting considerable levels of radio noise which should be properly considered and controlled at the design stage."

Low Power Devices...The FCC has denied a July 1982 petition by RF Power Labs for an exemption from the commission's rules to allow the operation of a portable low power audio-video transmitter in the 471-507 MHz band. Five parties opposed the petition on the grounds that the proposed device would interfere with the reception of UHF TV channels 14-20. For more information, contact FCC's Alvin Reiner, (301) 725-1585.

INTERNATIONAL

Power Line Exposures in USSR...Drs. I.P. Kozyarin and Yu.D. Dumanskiy of the Institute of General and Communal Hygiene in Kiev have advocated a maximum permissible dose of 12 kV/m "for occasional, short-term" exposures of up to 30 minutes a day and 5 kV/m for "daily short-term exposures" to 50 Hz electric fields. In addition, they favor a requirement that 500 and 750 kV power lines be at least 300-500 meters from inhabited areas, and that any human activity requiring frequent exposure within this zone be prohibited, like farming. The paper is written in Russian and was published in the November 1983 *Gigiyena i Sanitariya* in Moscow. An English abstract appears in the

UPDATES

May 18, 1984 issue of *USSR Report: Life Science: Biomedical and Behavioral Sciences*, published by the Joint Publications Research Service (JPRS) which is available from the National Technical Information Service, Springfield, VA 22161. (Note that JPRS has discontinued its *USSR Report: Life Sciences: Effects of Non-Ionizing Electromagnetic Radiation* and is now publishing abstracts on NIER in the report cited above.)

Documentaries in the UK...Central Independent Television, based in London, has prepared a three-part series on non-ionizing radiation, called *The Good, the Bad and the Indefensible* for Channel 4 in the UK. The three shows and their air dates were: "Hidden Potential" (August 25); "Currently at Risk" (September 1); "Opening Pandora's Box" (September 8). The series was produced by David Jones and directed by Richard Belfield. Part 1 focussed on medical applications, including bone and ulcer healing and the treatment of lung and chest cancers with electric current. Part 2 was about the risks associated with power line radiation. Among those interviewed on the show were Dr. John Bonnell of the Central Electricity Generating Board, Dr. Stephen Perry, a general practitioner who has investigated the possible association between power lines and suicide, and Dr. Robert Becker, who has been an active participant in the health effects of ELF debate. Part 3 covered a number of topics related to the politics of non-ionizing radiation: the beaming of radiation at the US embassy in Moscow, Project Pandora, the Soviet Woodpecker over-the-horizon radar, Joe Towne of the Radar Victims Network, EMP radiation and VDTs. For further information, contact: Jean Denham, Press Office, Central Independent Television, 35-38 Portman Square, London W1A 2HZ, England, (01) 486-6688.

MEETINGS

Low Level Effects...Eugene Findl of Brookhaven National Lab is organizing a two-and-a-half day workshop on the interaction of low level electromagnetic and ultrasonic fields with cells on December 9-12. The main objective of the meeting, which is by invitation only, is to explore possible mechanisms. The proceedings of the workshop will be published. For more information, contact Findl at Brookhaven National Lab, Upton, Long Island, NY 11973, (516) 282-4907...Because of the number of conferences already scheduled, ONR's Dr. Mike Marron has decided against holding a workshop on low frequency magnetic field effects (see *MWN*, June 1984). "There are so many other meetings that I just couldn't schedule another one," Marron told *Microwave News*. Instead, he is planning a joint FDA-ONR review session to identify future research directions in basic science, applications and hazards assessment. The session will be held in November. Marron added that he expects ONR to fund more research on low frequency field effects in the future.

Call for Papers...The 17th Annual Meeting of the Conference of Radiation Control Program Directors in Mil-

waukee, WI, May 19-23. Contact: CRCPD, 71 Fountain Place, Frankfort, KY 40601, (502) 227-4543....The 1985 *IEEE International Microwave Symposium* in St. Louis, MO, June 4-6. Contact: Stephen Honickman, STG ElectroSystems, 720 Manchester, Suite 215, Ballwin, MO 63011....The *International Aerospace and Ground Conference on Lightning and Static Electricity*, in Paris, France, June 10-12. In the US, contact: Lawrence Walko, AFWAL/FIESL, Wright Patterson AFB, Dayton, OH 45433; others: Dr. Joseph Taillet, ONERA, BP 72, 92320 Chatillon, France....The 1985 *International Symposium on Microwave Technology in Industrial Development - Brazil*, Campinas, Brazil, July 22-25. Contact: Attilio Jose Giarola, UNICAMP-CCPG (Reitoria), CP 1170, 13100 Campinas, SP, Brazil....The 1985 *International Symposium on Electromagnetic Compatibility* in Wakefield, MA (near Boston), August 20-22. Contact: Dr. Donald Weiner, Department of Electrical and Computer Engineering, 111 Link Hall, Syracuse, NY 13210.

MILITARY SYSTEMS

TEMPEST Revisions...The Defense Communications Agency (DCA) has announced plans to upgrade its Circular 370-D195-2. The circular governs the activities of the Data Communications TEMPEST Working Group (DTWG) in evaluating equipment for certification for use in the Data Communications portion (AUTODIN) of the Defense Communications System. DCA is soliciting views to streamline the certification process as well as to make it more economically efficient. For more information, contact: Louis Gnecco, chairman, DTWG, DCA, Attn: B665, Washington, DC 20305, (202) 692-4603. Note that because the TEMPEST program is classified, only those with the proper security clearances can participate....Of related interest, see James Schultz's article, "NSA and Industry Experience TEMPEST Growing Pains," in the June *Defense Electronics*.

OCCUPATIONAL HEALTH

RF Sealer Guidelines...FDA will soon propose draft, voluntary guidelines for radiation exposures from RF dielectric heaters and sealers. FDA's Center for Devices and Radiological Health will recommend the ANSI levels of 60 V/m and 0.16 A/m for electric and magnetic fields, respectively. Though some heaters and sealers operate at frequencies below 30 MHz, FDA will propose flat guidelines instead of ANSI's frequency dependent levels, which are less stringent below 30 MHz. A meeting has been scheduled for November 15-16 to allow interested parties to comment on the FDA proposal. An explanatory notice will appear in the *Federal Register*. For more information, contact Howard Bassen, acting deputy director of the Division of Physical Sciences, HFZ-130, CDRH, Rockville, MD 20857, (301) 443-6536.

PEOPLE

Dr. Richard Phillips is leaving Battelle to become the di-

rector of the Experimental Biology Division at EPA's Office of R&D in Research Triangle Park, NC. Phillips will leave his post as program director for bioelectromagnetics at Battelle's Pacific Northwest Labs in Richland, WA, at the end of October and expects to be at EPA by the end of November. He will be taking over from Dr. **Joe Elder** who has been filling in as acting division director since January 1982 when Dr. **Dan Cahill** left EPA for a job with Carolina Power and Light. Elder will continue as chief of the division's cellular biophysics branch...Dr. **Geoffrey Voss** of the University of Alberta in Canada, has replaced Dr. **Satish Kashyap** as the editor of the *Journal of Microwave Power*. In a telephone interview, Voss said that he planned to beef up the IMPI journal and expand coverage in a number of areas, including patents, R&D, new products, medical applications and standards. His goal, he said, is to make the publication complementary to *Bioelectromagnetics*, the BEMS journal...Dr. **Robert Patterson** has taken over Dr. **Robert Kavet's** post as manager of EPRI's project on the biological effects of electric fields. Patterson has been with EPRI for three years and before that was at SRI International. Patterson will report to Dr. **Gordon Newell**...On August 6, Dr. **Abraham Lilienfeld** died of a heart attack in Baltimore, MD, at the age of 63. Lilienfeld was a leading epidemiologist and is best known to the RF/MW community as the principal investigator on the study of employees who were exposed to microwaves at the American embassy in Moscow.

STANDARDS

San Diego Weighs ANSI Limits...An advisory panel has recommended that San Diego County, CA, adopt the 1982 ANSI standard for RF/MW radiation. This is one of a number of recommendations, including changes in zoning and site development policy, made by the Telecommunications Task Force in its recently completed final report to the county's Board of Supervisors. Late last year, the board declared a moratorium on new broadcast construction permits and established the task force. This group's recommendations "are intended to serve as the basis for the development of a regional telecommunications policy," according to the report, because, "while criteria and guidelines have been recommended which will mitigate site-specific development impacts, issues regarding alternative site locations are likely to involve multi-jurisdictional decisions." Part of the task force effort included commissioning a study on *Potential Hazards of Radio and Microwave Frequency Radiation - An Overview*, from the Tinton Falls, NJ, consulting firm of Booz, Allen and Hamilton, Inc. The firm's 19-page report concludes that "there appears to be no radiation hazard to the public" from existing RF/MW sources in the county. The board is scheduled to act on task force recommendations on September 12, the day before the moratorium expires. For more information, contact Bill Chatham, Department of Planning and Land Use, County of San Diego, 5201 Ruffin Road, Suite B, MS 0650, San Diego, CA 92123, (619) 565-3023.

EMC in Canada...The Canadian Standards Association's (CSA) steering committee on EMC is without a chairman. Max Melnyk of the federal Department of Communications has been reassigned and has given up the chairmanship. According to CSA's Brian Weir, no replacement has yet been named. Meanwhile, one of the groups working under the EMC steering committee is developing an immunity standard for data processing equipment which should be ready in 1985. Last year, the subcommittee, chaired by Sam Wong of Delphax Systems in Mississauga, Ontario, issued standard C108.8, *Recommended Limits and Methods of Measurement of EMI from Data Processing Equipment and Electronic Office Machines*. For more information, contact Wong at (416) 624-2643 or Weir at (416) 747-4363. A copy of C108.8 is available for \$16.00 (Canadian), prepaid from CSA, 178 Rexdale Blvd., Rexdale, Ontario M9W 1R3, Canada, (416) 747-4044. You can use Visa, MasterCard and American Express.

Are Public RF/MW Health Standards Needed?...This is the question raised by Jane Clemmensen in her new book, *Non-Ionizing Radiation: A Case for Federal Standards?* Clemmensen concludes that there is no *a priori* need for a national RF/MW exposure standard because of an "absence of evidence of jeopardy to public health." Her 90-page analysis explores the risks to emerging technologies of an unscientific standard, the costs of delays and litigation in the absence of officially recognized guidelines and possible alternatives to a national standard. Dr. Arthur Guy wrote the preface to the paperback book, which is available for \$7.50 from San Francisco Press, Box 6800, San Francisco, CA 94101.

IEEE Dictionary...A revised and expanded edition of the *IEEE Standard Dictionary of Electrical and Electronics Terms* has been issued. Designated ANSI/IEEE Standard 100-1984, the 1173-page book contains nearly 24,000 definitions. The volume, now in its third edition, also features some 15,000 acronyms. The text is chock-full of diagrams and equations and is a most useful reference. Copies are \$33.75 for IEEE members (\$37.50 for non-members) until December 15, when the price goes up to \$44.95 and \$49.95, respectively (add \$2.00 handling and shipping charge per order). Available from IEEE Service Center, CP Dept., 445 Hoes Lane, Piscataway, NJ 08854, (201) 981-0060.

CISPR ITE Rule...The new CISPR six months' draft rule on information technology equipment is now available. This standard could have a major impact on FCC Part 15 rules on computer emissions (see *MWN*, May 1984). *CISPR/B(Central Office)16 Second Draft - CISPR Recommendation No. ...: Information Technology Equipment: Limits of Interference and Measurement Methods* can be ordered from Sales Dept., ANSI, 1430 Broadway, New York, NY 10018. Send a check for \$31.00 with your order (price includes postage).

1983). The most powerful effects were found using pulses with a 42 usec rise time, though significant effects also occurred using pulses with a 2 usec rise time. Delgado used very weak magnetic fields ranging in intensity from 0.1-100 microtesla (uT). (By comparison, the Earth's static magnetic field is approximately 50 uT.) At least three groups are trying to replicate the experiments though only Mild, of Sweden's National Board of Occupational Safety and Health, has been successful (see *MWN*, June 1984).

Very low frequency (VLF) radiation emissions are produced by the VDT's flyback transformer, which controls the electron beam's movement across the inside face of the display screen. Recent measurements, described below, indicate that there is a long magnetic field pulse associated with the horizontal tracing of a raster line from left to right and a very short electric field pulse associated with the rapid return to the left to start a new line.

The magnetic field waveform from the flyback has a rise time of approximately 45 microseconds (usec). The observed values vary according to the flyback frequency — the pulse repetition rate can change from 15-20 kHz. There also appears to be a fast magnetic field pulse associated with the short electric field pulse, which has a rise time of about 5 usec.

The shape of the electromagnetic pulse determines the time rate of change of the magnetic field; time-varying magnetic fields induce electric currents. It is not clear, however, whether induced currents or other mechanisms — possibly direct magnetic interactions — cause the Delgado effect. For instance, in a paper published earlier this year, Dr. Abraham Liboff of Oakland University in Rochester, MI, showed that weak alternating magnetic fields could alter DNA synthesis and that the effect was independent of the induced current (see *Science*, 223, 818, 1984, and *MWN*, October 1983).

Guy's Data

At a conference on "Office Hazards: Awareness and Control" in Seattle, WA, on June 1, Guy reported that the magnetic field pulses from VDTs have rise times of approximately 40-60 usec and fall times of 10 usec, "characterized by a sawtooth-wave shape." Average (rms) field strengths at the surface of terminals were on the order of 1 A/m, decreasing to 0.02-0.14 A/m at a distance of 25-30 cm from the screen.

Guy also measured the electric fields produced by flybacks. These were in the form of 10 usec wide pulses separated by 50-70 usec intervals. The peak amplitudes

were approximately five times greater than the average. "For typical VDTs, the peak electric field levels may be as high as several thousand volts per meter [V/m] at the surface of the unit nearest the flyback transformer and near 10 V/m at 25-30 cm from the screen," Guy wrote in the abstract of his conference paper. He noted some significant exceptions, however: "these values can be ten to twenty-five times greater for some older models."

In a subsequent telephone interview, Guy said that the electric fields at 25-30 cm from the screen were approximately 5 V/m for new VDTs and about 50 V/m for old ones.

Guy advised in his abstract that, "Though there is concern about the health hazards of the emissions, the levels are far below accepted safety standards, and energy coupled to a user of the device is very small."

Guy told *Microwave News* that Delgado's experiments indicated the VDT pulse shape might not be biologically active. He said that he had observed a small ripple on the top of the VDT's magnetic field waveform; when Delgado added a ripple to the 42 usec pulse it was no longer teratogenic.

Guy tested terminals made by Digital Equipment Corporation (DEC), Hazeltine, Televideo and others and found similar pulse shapes for all units. Flyback frequencies varied between 15 and 18 kHz.

Guy has been studying VDT radiation for IBM. The company hired him to analyze the available literature and to suggest methodologies for measuring non-ionizing radiation emissions from VDTs. He took his own measurements when he found inconsistencies in the literature. An IBM spokeswoman would not say whether company officials had seen Guy's waveforms. A report Guy submitted to the company has been returned for revisions, she said. IBM is not planning to release the final report.

The conference proceedings, including Guy's abstract, are available from the Department of Environmental Health, University of Washington, SC-34, Seattle, WA 98195.

EPA Measurements

Tell, who works at EPA's radiation lab in Las Vegas, NV, described his measurements of the magnetic field pulses at the Bioelectromagnetics Society (BEMS) meeting in July.

Tell tested Wang and Hewlett-Packard VDTs and a Sony television set (used as a computer monitor), reporting the magnetic flux density for the short magnetic pulse in terms of microtesla (uT). (For comparison with Guy's results, Tell's values are also given in ampere/meter (A/m), using the conversion factor of 1 uT=0.8 A/m.) Peak magnetic field readings ranged from 1.44 uT [1.15 A/m] for the Hewlett-Packard to 6.48 uT [5.18 A/m] for the Sony. Maximum time rates of change for the magnetic fields, measured near the flybacks at the rear of the units, were 0.222 T/sec for the Hewlett-Packard, 1.12 T/sec for the Wang and 0.926 T/sec for the Sony.

At 5, 10, 15 and 20 inches from the screen, the time rates of change dropped off sharply. At the furthest distance, however, they were all still in the range used by Delgado.

Delgado did not publish the time rates of change for his

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experiments, but according to Tell's calculations they ranged from 0.0029 T/sec to 0.29 T/sec.

Tell reported that he observed the magnetic field pulse rise times to be on the order of a few usec. Neither Guy nor the researchers from Ontario Hydro found this fast pulse. Guy told *Microwave News* that, "I feel certain that the 2 usec pulse is peculiar to the particular VDTs studied." Tell was visiting Delgado's lab in early September and could not be reached for further comment.

Ontario Hydro and FDA

Murray Walsh, of Ontario Hydro in Pickering, Ontario, described measurements of some of the VDTs used at the utility company in a paper presented on August 29 at an *Open Symposium on the Interaction of Electromagnetic Fields with Biological Systems* held during the general assembly of the International Union of Radio Science (URSI) in Florence, Italy. In his "Assessment of the Hazards from Video Display Units," Walsh said that Ontario Hydro had "completely characterized the electromagnetic waveforms" as part of a major project to assess VDT hazards (see *MWN*, April 1984).

Explaining these data in a subsequent telephone interview, Walsh, who is manager of the company's Technical Safety Standards Section, said that the magnetic field pulses had rise times of approximately 40 usec and fall times of approximately 4 usec.

Walsh and Harvey measured the magnetic fields along three orthogonal axes near the VDTs. Along one of these,

Murray noted, the waveform was very complex.

Walsh also described 17 kHz electric field pulses as having short rise and fall times—approximately 4 usec each—separated by an estimated 52 usec. The wave shape was triangular, and the overall pulse duration was 60 usec. (A sample electric field waveform is pictured in a report on Ontario Hydro's findings in *Bioelectromagnetics*, 5, 1, 1984.)

In a telephone interview, FDA's Paul Ruggera said he had made some preliminary measurements of waveforms from two VDTs a few years ago. He explained that the magnetic field levels were so low that he did not measure them directly; instead he studied the spectral distribution of the signals.

Ruggera's data are published in *An Evaluation of Radiation Emissions from Video Display Terminals*, published by FDA in February 1981 (No. FDA 81-8153). The report is reprinted in the record of the May 1981 hearings of the House subcommittee on investigations and oversight of the Committee on Science and Technology, *Potential Health Effects of VDTs and RF Heaters and Sealers*.

A fifth set of measurements has been released in Canada but was not available at press time. In a study requested by the Hospital Employees Union of British Columbia, Dr. Hari Sharma of the University of Waterloo in Ontario measured radiation from VDTs at the Surrey Memorial Hospital in Vancouver. The hospital was the site of one of the eleven reported clusters of problem pregnancies (see *MWN*, July/August 1982). ●

CONFERENCES

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

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

October 5-6: **1st Congress of the European Society of NMR in Medicine**, Geneva, Switzerland. Contact: Dr. M.-A. Hopf, 1 route de Florissant, CH-1206 Geneva, Switzerland, (41)(22) 472547.

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

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

October 21-24: **1984 Conference on Electrical Insulation and Dielectric Phenomena**, Wilmington Hilton Hotel, Clayton, DE. Contact: Steven Boggs, Ontario Hydro Research, 800 Kipling Ave., Toronto M8Z 5S4, Canada, (416) 231-4111, ext. 6735.

October 21-26: **Managing the Electromagnetic Environment**, Pocono Hershey Resort, White Haven, PA. Contact: Harold Comerer, Engineering Foundation, 345 East 47th St., New York, NY 10017, (212) 705-7835.

October 22-23: **International Conference on Microwave Tubes in Sys-**

tems: Problems and Prospects, London, England. Contact: Institution of Electrical Engineers, Savoy Place, London WC2R 0BL, England, (01) 240-1871, ext. 222.

October 22-24: **International Symposium on Noise and Clutter Rejection in Radars and Imaging Sensors**, Sasakawa Hall, Tokyo, Japan. Contact: Professor T. Musha, Dept. of Applied Electronics, Tokyo Institute of Technology, 4259 Nagatsuta, Midori-ku, Yokohama, 277, Japan, (045) 922-1111, ext. 2546.

October 22-26: **9th International Conference on Infrared and Millimeter Waves**, Osaka, Japan. Contact: Professor A. Mitsuishi, Dept. of Applied Physics, Osaka University, Yamada-Oka, Suita, Osaka 565, Japan.

October 31-November 2: **Conference on Medical and Biological Effects of Light**, Barbizon Plaza Hotel, New York, NY. Contact: New York Academy of Sciences, 2 East 63rd St., New York, NY 10021, (212) 838-0230.

November 5-7: **DOE-EPRI-NYS Contractors Review: Research on Bioeffects of Transmission Lines**, Sheraton St. Louis, MO. Contact: Dr. William Wisecup, Aerospace Corp., Suite 4000, 955 L'Enfant Plaza, SW, Washington, DC 20024, (202) 488-6328.

November 5-8: **4th International Meeting of the Bioelectrical Repair and Growth Society**, Holiday Inn, Kyoto, Japan. Contact: BRAGS, 425 Medical Education Building, 36 and Hamilton Walk, Philadelphia, PA 19104, (215) 898-8653.

November 13-15: **JINA'84: International Symposium on Antennas**, Nice, France. Contact: Secretariat JINA'84, CNET-PAB Centre de la Turbie, 06320 Cap d'Ail, France.

FROM THE FIELD

University of Washington on Microwave-Cancer Study

Last month, we featured a report on a study by Dr. Arthur Guy at the University of Washington School of Medicine, which linked microwaves to the promotion of cancer. In response to our report and numerous other news stories appearing nationwide, the university's Health Sciences News and Information Services issued a press release on August 24.

Reprinted below is the full text of the University of Washington press release.

The stories also drew a critical response from the Electromagnetic Energy Policy Alliance (EEPA), an association of manufacturers and users of systems which employ non-ionizing radiation. In a September 8 release, EEPA Vice-President George Wilkening stressed the preliminary nature of the Guy results and noted that "there is nothing definitive...to support a conclusion that continuous exposure to radiofrequency and microwave fields is harmful to humans at the protection guide levels specified by the American National Standards Institute in 1982." Wilkening works for AT&T Bell Labs.

Over the past three years the Bioelectromagnetics Research Laboratory at the University of Washington has conducted, under the School of Aerospace Medicine's sponsorship, a biological screening study of the effects of continuous long-term exposure to low levels of microwave radiation. The major emphasis was to expose a group of rats to microwaves throughout their lifetimes and to monitor them for possible cumulative effects on general health and longevity. Two hundred animals were studied, one hundred being exposed and one hundred serving as controls.

Literally thousands of measurements were taken during the course of the study, covering many areas such as behavior, blood chemistries, metabolism, the immune system, weight and survival. All animals were also investigated at necropsy for the occurrence of lesions.

The overwhelming majority of the measurements showed that there was no difference between the animals exposed to microwaves and the controls, and in particular, there was no difference in survival between the two groups. However, several differences did emerge which merit further study:

1. There was some evidence of altered immune function, based on 10 exposed and 10 control animals sacrificed midway through the experiment, though this was not seen in animals sacrificed at the end of the experiment.
2. There was a suggestion of an increase in the weight of the adrenal glands in the exposed group, based on 10 exposed and 10 control animals sacrificed at the end of the experiment; however, this was not seen in animals sacrificed midway through the experiment.
3. There was a possible increase in the number of exposed animals with malignant tumors, which occurred in 16 of 100 animals in the microwave group and 4 of 100 control animals.

There are several reasons why these differences cannot be regarded as being definitively established. First, in a screening study such as this, with so many aspects being investigated, it is inevitable that some differences will appear by chance in the data obtained from the two groups, even if microwaves have absolutely no biological effect. Second, we have not completed the analysis of the results and, in particular, have not finished exploring the relationships between measurements and possible anomalies in the data. Third, with regard to tumors, the incidence is not significantly different in the exposed group compared to that in other unexposed groups of the same type of animals reported in the scientific literature. Finally, there wasn't a substantial increase in any specific type or location of tumor, differences emerging only when all tumors are considered, leaving biological interpretation open to question.

Nonetheless, the implications for public health of these results are such that further studies need to be done, designed specifically to address the issues raised by our research results.

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Books from San Francisco Press

Three books on RF exposure policy: Clemmensen, **Nonionizing Radiation: A Case for Federal Standards?** (\$7.50); Steneck, **Risk/Benefit Analysis: The Microwave Case** (\$15); Marha *et al.*, **EM Fields and the Life Environment** (\$10). Prepaid orders to San Francisco Press, Inc., Box 6800, San Francisco, CA 94101-6800. (Californians add tax.)

VDT Health and Safety Publications

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