Radiation Accident (continued from p.1)

Two of the six men were hospitalized following the accident for nausea, headaches, dizziness, extreme fatigue and memory loss. Both have been released. Four of the six have been examined by doctors at the Air Force School of Aerospace Medicine at Brooks Air Force Base (AFB) in San Antonio, TX.

A number of interviews with Richard Eldridge, one of the exposed workers, revealed there was a gross misunderstanding about the nature of radar radiation at the air force station and there were extensive delays in providing the exposed men with expert medical attention. Much of Eldridge's story was confirmed by one of his co-workers.

Few Official Details

The air force and its contractor at Clear have released few details about the accident. All requests for information from the air force are being directed to the North American Air Defense (NORAD) Space Command in Colorado Springs, CO. Kay Cormier, a public affairs officer at NORAD, told *Microwave News* that initial tests indicated the workers' exposure was "not life threatening," and that the medical condition of the exposed men will be monitored over the next six months.

Cormier said that the air force's best "guesstimate" was that the radar was turned on for no longer than seven minutes and that the power levels were above the air force's 10 mW/cm^2 safety standard.

The radar at Clear is maintained and operated by FELEC Services, Inc., a subsidiary of Federal Electric Corp., which in turn is owned by ITT. Four of the exposed men are FELEC employees; the two others were flown in to inspect the radar dish from McClellan AFB in Sacramento, CA, where they are civilian employees of the air force. An ITT spokesman said medical tests indicated that the exposed men could return to work and that they did. He also said their health would be monitored for at least six months.

The workers believe their radiation exposure was much more serious than the official statements suggest. Many of them are anxious about their injuries and suspicious of the treatment they received.

Misled by Radiation Badges

Eldridge, aged 40, is a welder who has worked at Clear for nine years. He was on the radar dish when the power was turned on and was later hospitalized. Eldridge accused FELEC of being lax and misinformed in the way it protected the workers. The safety officials at Clear did not know the difference between ionizing and non-ionizing radiation, he charged.

Eldridge said that he and his co-worker John Jessup had been repeatedly assured for *eight days* after the accident that their radiation badges would indicate the degree of their exposure. A week after the accident, Eldridge and Jessup were notified that lab tests on the badges showed they had not been overexposed. It was not until the following day, at a meeting with air force and FELEC personnel, that they were told the badges only measured exposures to ionizing radiation. Eldridge said that during the seven years he had worn a badge at Clear he had been told that it measured both ionizing and non-ionizing radiation.

Immediately after the accident, a supervisor wanted Eldridge and Jessup to return to work on the radar dish. They refused. The six men and the two electricians were later given a "Class C" examination by the company nurse. Eldridge described the exam as a check of their vital signs and a visual inspection of their bodies. He said that they were found to have elevated body temperatures and high blood pressure. The shoulders and back of Karl Kepler, one of the technicians from Sacramento, were red and sore. Eldridge had a wrist burn from radiation heating of the metal buttons on his denim shirt.

The next day, the men reported to work as usual. Six hours later, all eight men were sent to Fairbanks Memorial Hospital, where they were examined in the emergency room. Eldridge said that the doctors in Fairbanks told him that they had no experience with radiofrequency radiation injuries.

Jessup was hospitalized and the other seven men were sent home. On the 16th, two days after the accident, Eldridge checked into the hospital, complaining of headaches and partial loss of sight and memory. Eldridge was released on the 18th; Jessup stayed in the hospital for a week.

The symptoms reported by the workers are in general agreement with those reported after other radar accidents. For example, at a NATO workshop in 1981, Dr. Bernard Servantie detailed three case histories of radar overexposure. In general, the cases show that radar radiation can lead to overheating, dizziness, nausea, headaches, loss of memory and general asthenia (loss of strength and energy). Servantie is a physician with the French navy, based in Toulon. (Note that the frequency and power levels associated with a given radar can vary greatly.)

Very little is known about the long-term consequences of overexposure to radar radiation. The results of the only US epidemiological study (of navy radar workers) were inconclusive. A number of former radar technicians have won out of court settlements for their injuries, which include cataracts, deafness, pancreatic cancer, neurological disorders and impotence (see *MWN*, December 1982, January/February 1983).

Delays in Expert Medical Care

The men were not offered medical attention by doctors familiar with radiofrequency and microwave radiation until September 23, nine days after the accident. And then, according to Eldridge, they were told that they would have to wait for two more weeks because of a personnel shortage at the School of Aerospace Medicine at Brooks AFB.

The six men who were on the radar were given the opportunity to go to Brooks but two had no faith in the air force's objectivity and refused. As one observer familiar with the accident put it, "They did not think they would get a fair shake."

The two electricians who were at the base of the radar at the time of the accident were not thought to have been overexposed to radiation and were not invited to go to Brooks.

Eldridge and three of the other workers arrived at Brooks between the 10th and the 12th of October. By the 22nd, all the tests had been completed. Eldridge said that his loss in vision was documented at Brooks, as was a partial loss in hearing which developed two weeks after the accident.

According to Eldridge, one of the doctors at Brooks suggested that his medical condition might be attributable to hysteria, anxiety, life-style or depression. The physician never mentioned radiation as a potential cause of his illness.

Eldridge and some of the other men are now seeking additional medical opinions. Since he left Texas, Eldridge has consulted with Dr. Milton Zaret, an ophthalmologist in Scarsdale, NY, who is an expert on non-ionizing radiation.

Lt. Col. George Schwender, chief of the flight medicine branch of the clinical sciences division at Brooks, was in charge of examining the workers. In a telephone interview, he said that the medical reports had not yet been completed. He added that each man would receive a copy of the medical tests for his own use.

A detailed report on the accident is being prepared by the air force's Inspection and Safety Center at Norton AFB in California. It should be completed in December, NORAD's Cormier said.

(Note that: The air force's standard governing exposures to radiofrequency radiation, No. 161-9, cites rules for the "medical investigation of incidents and accidents." In part, it states: "It is essential that every suspected or actual overexposure to RF radiation be thoroughly investigated and evidence of injury or absence of injury thoroughly documented....Personnel who may have been overexposed should be evaluated...The evaluation should be made at the nearest USAF medical facility as soon as practical after the event.")

Accident Simulation

A team of "bioenvironmental engineers" was assembled at Clear on September 22 to reconstruct the incident with the help of the workers. According to Cormier, the simulation indicated that the radar was turned on for no longer than seven minutes and that the exposure levels were above 10 mW/cm^2. She would not elaborate on how high the levels might have been.

Eldridge provided a different and more extensive description of the radar tests and their results. He said that he and his co-workers believe the radar was on a *minimum* of eight minutes and possibly as long as 17 minutes. Their estimate is based on an inspection of the station's power plant records, which indicated that there was a power surge at the time of the accident that lasted 17 minutes.

According to Eldridge, the air force estimated that the men were exposed to power densities of 40-45 mW/cm^2, but that technicians present during the simulation thought that the exposure levels were closer to 135 mW/cm^2. Eldridge stressed that the air force did not deny that this higher exposure was possible.

Some of the technicians told Eldridge that the air force was making the most conservative assumptions in recreating the incident and estimating the degree and extent of exposure. The net effect was to minimize the severity of the accident, he argued. For instance, the simulation was run with the radar operating at a lower power setting than was the case during the accident; Eldridge believes the wrong correction factor was used to extrapolate the exposures from the lower to the higher power setting.

Eldridge criticized the air force for taking eight days to assemble the simulation team in an effort to understand what had happened to him and his co-workers, even though the two experts who ran the tests were already in Alaska.

Unreported Accidents at Clear

David Clarke, an electrician who spent 19 years at Clear until he was terminated in 1979, told *Microwave News* that "there have been numerous unreported accidents at the air force station." Clarke said that radiation safety was essentially ignored while he was at Clear. When radiation levels were measured in the last years he was there, he added, levels over 10 mW/cm^2 were often found. Describing one incident, Clarke said that "painters found sparks shooting out from their paint brushes."

Clarke is suspicious about a possible cluster of brain tumors among a small number of men he worked with. He said that there were three deaths from brain tumors among the twelve men in his department during approximately a seven year period. (There was some turnover among the men during this time.)

Clarke, now a Seattle, WA, resident, has cataracts on both the posterior and anterior sides of the lenses of his eyes. He also suffers from retinitis pigmentosa, a hereditary condition that limits his field of vision.

AN/FPS-92 Radar

The tracking radar, designated AN/FPS-92, operates at a number of frequencies in the ultra high frequency (UHF) band (300 MHz-1 GHz), with an output power at megawatt levels. It emits 27 pulses per second. The radar has a maximum range of more than 3,000 miles. The AN/FPS-92 is an improved version of the AN/FPS-49 radar which is in operation at the two other BMEWS sites in Greenland and in the United Kingdom.

The radar is housed in a golf ball shaped dome. It has a diameter of about 92 feet, while the dome has a diameter of 140 feet. There was an AN/FPS-49 installation in Moorestown, NJ, next to the New Jersey Turnpike, but the unit was phased out in 1974 and later torn down.

In addition to the tracking radar, there are three stationary screens that also emit radar radiation at Clear. Each of these are, as NORAD's Cormier phrased it, "as big as football fields." ●

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HIGHLIGHTS

Newspaper Guild Study Confirms VDT Health Problems

VDT users are likely to suffer vision problems, musculoskeletal disorders, headaches and stress according to a study sponsored by the Newspaper Guild. Dr. Arthur Frank, the study director, also concluded that the potential risks of cataracts, skin rashes and reproductive problems cannot be determined on the basis of current scientific data, including his own research.

Frank announced these findings at a congressional hearing on October 18. He told the subcommittee on health and safety of the House Committee on Education and Labor that his survey of 1,047 guild members confirms that eye problems, neck, shoulder and low back pain all "clearly result" from ergonomic factors. These same factors may also cause personality changes, irritability and sleeping problems.

The new study findings confirm previous research by the National Institute for Occupational Safety and Health (NIOSH) (see *MWN*, May 1981).

Frank's data also agree with the results of a literature review done by the National Academy of Sciences (see *MWN*, July/August 1983). Frank and the NAS study panel disagree on how to interpret the findings, however. Frank testified in support of further study. "What this data tells me," Frank said in an interview, "is that the three things we need most are more research, more research and more research."

NAS discouraged further research on VDT safety, while recommending improved workstation design and management practices. The study panel urged that "competing priorities in the field of occupational health be carefully considered" in planning research related to VDTs.

Guild President Charles Perlik, Jr., warned that operators have "lingering and lasting fear and concern" that can be dispelled only by "ongoing, long-term research." David Eisen, research director for the guild, told the subcommittee that the Occupational Safety and Health Administration (OSHA) should be directed by Congress to set ergonomic standards. Similarly, Frank called for an interim standard requiring regular work breaks for operators.

After hearing the testimony, subcommittee chairman Joseph Gaydos (D-PA) acknowledged that "we have a problem" and announced that the subcommittee's work on VDTs will continue. Under consideration are more hearings, a staff investigation and informal discussions with experts in the field.

Other study findings include:

- The "constellation" of ergonomic problems confirmed by the survey may be responsible for a greater loss of work time among VDT users compared to non-users, a problem of "potentially major magnitude with regard to the economics of work."
- A link between VDTs and cataracts is possible. One site produced five cases of cataracts in the five years prior to the survey. Frank urges further investigation of this irregularity, as well as more general research on cataracts among VDT users.
- The matter of reproductive effects is "unsettled." The reproductive histories of men as well as women were studied and more birth defects were found among male users' offspring than among those of females. Further investigation of possible spermatogenesis due to VDT use is recommended.
- There was no noticeable change in sexual activity, but VDT operators commented more than non-users on being irritable, having trouble sleeping and experiencing difficulty waking up. In addition, non-users reported having more energy.

Frank acknowledged "some methodological problems" with the study but defended its scientific validity. He said he now has "one of the largest bodies" of questionnaire data available.

Approximately 3,000 survey questionnaires were distributed at six sites (St. Louis, Memphis, Vancouver, Toronto, Honolulu and New York) to reporters, editors, advertising staff members and clerical employees. A total of 1,109 responses were received, of which 1,047 were usable. Nearly three-fourths of the completed questionnaires came from VDT users, with a nearly equal number of men and women respondents. A higher pecentage of men used terminals.

Additional data from ophthalmological examinations of selected survey participants is scheduled for release next spring.

When the study was announced in March 1981, Dr. Frank was affiliated with the Mount Sinai School of Medicine in New York. The study was completed shortly before he left Mount Sinai to become Chairman of the Department of Preventive Medicine and Environmental Health at the University of Kentucky College of Medicine at Lexington.

The oversight and investigation subcommitee of the House Committee on Science and Technology, which in 1981 held the only other congressional hearing on VDTs, is not planning any immediate action (see *MWN*, June 1981). A subcommittee spokesman told *Microwave News* that chairman Albert Gore, Jr. is waiting for the outcome of a planned NIOSH epidemiological study of pregnant VDT operators, for which a study population is being sought (see *MWN*, July/August 1983).

Single copies of the report, *Effects on Health Following Occupational Exposure to Video Display Terminals*, can be obtained from David Eisen at the Newspaper Guild, 1125 15th Street, NW, Washington, DC 20005, (202) 296-2990.

Submillimeter E-Field Probe

Professor Ted Batchman of the University of Virginia has built an electric field probe which is less than one millimeter wide. The new probe is two or three times smaller than currently available models and, when fully operational, will be implantable in living tissue. In addition to applications in biological effects studies, Batchman hopes it will be used for electromagnetic compatibility measurements.

The probe, developed under a grant from the National Science Foundation (NSF), still needs some refinements. In

a telephone interview from his office in Charlottesville, Batchman said that he began with a glass substrate for the probe, but is now using mylar, a flexible nylon material, to make it less bulky.

According to Batchman, the probe can detect a minimum signal of less than 10 V/m. The calculated sensitivity is 4.5 V/m, but he believes it is actually about 1 V/m. According to theoretical calculations, the instrument's frequency range is 13 MHz to 77 GHz. Batchman hopes to have a three-axis probe, with an external diameter of about one millimeter, by early next year.

Batchman's NSF grant will not be renewed when it expires in December, and he is considering setting up a joint venture with a private company to complete the development of the probe. A group in Ottawa, Canada, has expressed an interest in working with him as well. Batchman said his optimism about securing continued financing "varies from day to day."

The Food and Drug Administration (FDA) would also like to see the probe refined. Howard Bassen at FDA's National Center for Devices and Radiological Health said that his agency is seeking interested parties to finance the completion of the probe.

A description of the probe appears in the September issue of *IEEE Transactions on Microwave Theory and Techniques*. Bassen and Glenn Smith of Georgia Institute of Technology, both of whom assisted Batchman in his work, have published "Electric Field Probes —A Review" in the September *IEEE Transactions on Antennas and Propagation*.

NBS RFI Tests on Breath Analyzers

Breath analyzers are a reliable way to check driver sobriety, according to the National Bureau of Standards (NBS) and the National Highway Traffic Safety Administration (NHTSA). Although bureau tests have demonstrated that some of the devices are susceptible to radiofrequency interference (RFI), both organizations have concluded that proper operating procedures can eliminate the risk of interference-induced errors in the measurement of alcohol concentration.

This assurance, published in a May 1983 report, is good news for law enforcment officials who use analyzer readings as evidence in court. NHTSA has advised state and local jurisdictions that they can ensure the legal admissibility of these readings by setting up programs for periodic RFI testing.

Last year several state police departments reported that their analyzers were affected by walkie-talkie and patrol car radio transmissions. The accuracy of one unit, Smith and Wesson's widely used Breathalyzer, was subsequently challenged in a suit brought in Minnesota (Heeden v. Dirkzwager, Ramsey County Second Judicial Court, 1982). Thanks to the state's RFI testing program, the reliability of the Breathalyzer readings was upheld.

Testing programs run in nine states late last year indicated that interference is in fact very rare. Following instructions and precautionary warnings distributed by NHTSA in January 1983, less than one percent of the units checked by the states were susceptible to RFI in the working environment.

NHTSA's recommendations were adapted from test protocols developed by Smith and Wesson (see *MWN*, March 1983) and by the Minnesota Bureau of Criminal Apprehension.

According to the report prepared by the bureau's Law Enforcement Standards Laboratory and released by NHTSA, nine out of sixteen units tested by NBS were affected by a 10 V/m field at one or more frequencies. Only three of the nine units registered more than a ± 10 percent change in readings when placed in a field, however. The bureau's Colorado lab exposed analyzers to four frequencies (46, 160, 460 and 850 MHz) used by law enforcement agencies. The 10 V/m field strength used approximates the environmental levels one meter from a 5-watt walkie-talkie or 10 meters from a 100-watt mobile radio. (NBS warns that its data cannot be extrapolated to other frequencies, field strengths, multiple frequency fields or other units of the same models.)

Commenting on the RFI controversy, Gerald Klein of Smith and Wesson said NBS and state tests indicate that the chance of interference in the field is extremely slight. According to Klein, the company's test procedures, which were released before the NBS report, can eliminate just about all risks of RFI.

Since problems were first reported two years ago, Smith and Wesson has retrofitted its Model 1000 Breathalyzer with a new electronic circuit to reduce possible interference. The Model 900 is not susceptible to RFI, but Klein said more caution is advisable when operating the 900A.

Smith and Wesson is not the only company to respond to user fears about RFI. Federal Signal Corp., for example, has advertised that its Intoxilyzer models produce "reliable, court-accepted evidence that RFI can't distort under normal operating conditions."

The 33-page NHTSA technical report, *Limited Electromagnetic Interference Testing of Evidential Breath Testers*, May 1983, DOT HS-806-400, is available from the National Technical Information Service, Springfield, VA 22161.

State RF/MW Standards Planned in New Jersey and Connecticut

Officials in New Jersey and Connecticut expect to propose general population exposure standards for radiofrequency and microwave (RF/MW) radiation next year. If the measures are approved, the states will join Massachusetts and several local jurisdictions which have already imposed exposure limits.

Last month, New Jersey's Commission on Radiation Protection recommended that the state formally adopt the new American National Standards Institute's (ANSI) guidelines. At about the same time, Connecticut legislators held a hear-

ing to weigh the merits of ANSI's standard against Massachusetts', which is five times more stringent (see *MWN*, September 1982 and September 1983.) For the most strictly regulated frequencies, 30-300 MHz, the ANSI limit is 1 mW/cm^2 while the Massachussets limit is 200 uW/cm^2.

According to Jim Ross of the NJ Department of Environmental Protection (DEP), the state currently uses ANSI as its benchmark for evaluating RF/MW hazards and has found no public exposures anywhere near 1 mW/cm^2. A proposal to adopt ANSI and a schedule for public hearings are expected to appear in the state's *Register* within the next six months. (It would not apply to occupational exposures.)

The state standard will be replaced by federal limits as soon as they are set. In explaining the need for interim action, Ross echoed other officials in New Jersey and Connecticut who expressed disappointment over the pace of federal standards development.

In Connecticut, State Representative Moira Lyons is leading the Environment Committee's drive to propose a standard during the 1984 legislative session. Lyons is chairwoman of a special task force studying RF/MW hazards. As a first step toward developing a standard, the group held an invitational hearing on October 20 at which representatives from the Connecticut Citizen Action Group, Northeast Utilities, Raytheon, Southern New England Telephone and the Veterans Administration Medical Center testified.

The Connecticut task force is now trying to schedule a December meeting with representatives from Massachusetts' Radiation Control Program and the National Institute for Occupational Safety and Health before submitting its recommendations to the Environment Committee.

It is uncertain at this point what type of standard will emerge from the committee. After the October meeting, however, Lyons said she believes the broadcast and cable industry could live with limits well below the ANSI guidelines.

CONFERENCES

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, (212) 673-4700.

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, (617) 253-5561.

1984

January 11-14: ***National Radio Science Meeting,*** University of Colorado, Boulder. Contact: S.W. Maley, Dept. of Electrical Engineering, University of Colorado, Boulder, CO, 80309, (303) 492-7004.

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, (913) 864-4836.

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, (213) 475-4571.

January 27-29: ***Symposium on NMR Imaging,*** Fontainebleau Hotel, Miami Beach, FL. Contact: American College of Radiology, 6900 Wisconsin Ave., Chevy Chase, MD 20815, (301) 654-6900.

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, (301) 496-5133.

February 23-25: ***Biological Effects and Therapeutic Applications of ELF Electromagnetic Fields,*** Venice, Italy. Contact: Dr. Luigi Zecca, Association for Biomedical Applications of Electromagnetism, Via Gentilino 9/a, 20136 Milan, Italy, (02) 8321655.

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 (404) 424-9621.

March 23: ***Microwave and Millimeter Wave Solid State Devices and Circuits,*** RCA Labs, Princeton, NJ. Contact: Dr. Walter Slusark, RCA Labs, 201 Washington Rd., Princeton, NJ 08540, (609) 734-2946.

April 2-5: ***3rd Annual Test & Measurement World Expo,*** Brooks Hall, San Francisco, CA. Contact: Meg Bowen, 215 Brighton Ave., Boston, MA 02134. (617) 254-1445.

April 4-5: ***20th Annual Meeting of the National Council on Radiation Protection and Measurements,*** Washington, DC. Contact: NCRP, Suite 1016, 7910 Woodmont Ave., Bethesda, MD 20814, (301) 657-2652.

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, (703) 525-4890.

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, (512) 684-5111, ext. 2721.

April 30-May 3: ***5th Annual Meeting of the Canadian Radiation Protection Association,*** Banff, Alberta. Contact: Stuart Hunt, C-7 Civil Electrical Engineering Bldg., University of Alberta, Edmonton, Alberta T6G 2G7, Canada.

May 7-11: ***Nuclear Magnetic Resonance 1984: National Symposium,*** Hyatt Regency Grand Cypress Resort, Orlando, FL. Contact: Ms. Norine Karwel, Educational Symposia, PO Box 17241, Tampa, FL 33682, (813) 879-8765.

May 7-12: ***6th International Radiation Protection Association (IRPA) Congress,*** International Congress Center, Berlin, West Germany. Contact: R. Neider, Bundesanstalt fur Materialpurfung (BAM), Unter den Eichen 87, D-1000 Berlin 45, West Germany.

May 30-June 1: ***IEEE MTT-S International Microwave Symposium,*** San Francisco, CA. Contact: Dr. Ferdo Ivanek, Harris Corp., Farinon Division, 1691 Bayport Avenue, San Carlos, CA 94070, (415) 594-3529. The ***1984 IEEE Microwave and Millimeter Wave Monolithic Circuits Symposium*** will be held in San Francisco May 29-30 in conjunction with the MTT-S meeting.

June 3-7: ***29th Annual Meeting of the Health Physics Society,*** Hyatt Regency, New Orleans, LA. Contact: Richard Burk, Jr., HPS, 4720 Montgomery Lane, Suite 506, Bethesda, MD 20814, (301) 654-3080.

UPDATES

BIOLOGICAL EFFECTS

Thermal v. Non-Thermal (again)... The argument over whether there are non-thermal effects of RF/MW radiation continues. The latest round involves the World Health Organization's (WHO) *Environmental Health Criteria 16: Radiofrequency and Microwaves* (see *MWN*, March 1982) and a review by Professor Sol Michaelson which criticized WHO's "unqualified acceptance of postulated non-thermal bioeffects" (see *MWN*, December 1982). Four members of the WHO panel that prepared the report challenge Michaelson's critique as being "seriously biased by his commitment to the thermal mechanism of microwave-tissue interaction." Charges and countercharges appear in the August 1983 issue of *Radiation Research*. Noting that it has been four years since the document was written, the panel members state that today "a stronger case might be made for the significance and existence of non-thermal effects." Michaelson replies that "I have no commitment to any concept except scientific objectivity...I am not *committed* to thermal interactions" (emphasis Michaelson's). Another example from the exchange: The WHO panelists cite the transactions of 1981 and 1982 Biological Repair and Growth Society (BRAGS) meetings as indications that non-thermal effects exist. Michaelson answers that the transactions are irrelevant....As the dispute drags on, experimental evidence supporting non-thermal effects accumulates. Writing in the September 26 *Physical Review Letters*, Drs. W. Grundler and F. Keilman report that they have confirmed their earlier findings, which indicated "non-thermal resonant action of millimeter microwaves on the growth of yeast cultures." Their statistical analysis shows there is a "negligible probability" that the observed response, with peaks at 41.697 and 41.782 GHz, could be frequency-independent. The West German scientists conclude: "Our result enhances the weight of reports on other systems and poses the question of generality of this sensitivity in biology. Uncovering its origin will provide a fascinating interdisciplinary task."...There is more supporting data from Spain...

Delgado Varies Pulse Shape... Last March we reported that Dr. Jose M.R. Delgado's research group in Madrid, Spain, had found that extremely weak, 1.2-120 milligauss, pulsed magnetic fields can have a "consistent and powerful" effect on the development of chicken embryos. In a follow-up paper to be published soon in the *Journal of Anatomy*, the group looks at the influence of the shape of the pulse on chick embryos during their first 48 hours of development. The researchers used four different pulses, with varying rise and fall times, at approximately the same field intensities as in the original experiments. Among their findings: "Exposure to electromagnetic fields with a pulse rise time of 100 microseconds produced teratogenic changes when intensities of [10 and 139 milligauss] were used but not with lower or higher intensities, demonstrating a 'window' effect and ruling out the possible influence of a rise in internal embryonic temperature....When embryos were exposed to intensities of [4 and 10 milligauss] with 2.0 and 42 microsecond pulse rise times, teratogenic effects were greater and alterations involved all developing systems. The most powerful effects were obtained with [10 milligauss] and 42 microsecond rise time." They conclude that the pulse shape may be the "decisive parameter determining strong, slight or no modification of embryonic development," and that "mechanisms of action of electromagnetic fields are still unclear, but induced alterations in extracellular glycosaminoglycans could be a causal factor in the observed malformations."

COMMUNICATIONS

Siting Problems in New Jersey... Vernon, NJ, has apparently tempered its view of potential RF hazards. Since last year, a community group worried about RF health effects has blocked RCA Americom's plans for a new point-to-point tower at its Vernon satcom station (see *MWN*, November 1982 and March 1983). Although RCA still doesn't have official approval for its low power antenna, on October 20 the town zoning board granted the American Satellite Company a variance to add a 13-meter dish to its Vernon station. RCA now plans to submit a new application for upgrading its facilities. Amsat brought in consultants on RF safety, and after six hearings the board unanimously approved its request. Three conditions were attached to the variance, however: 1) Power densities at the edge of Amsat's property cannot exceed 1 uW/cm^2; 2) RF levels at the perimeter of the station must be measured annually for three years; 3) Amsat must install mechanical locks on the antenna to ensure that its elevation angle is always greater than 12.5 degrees. Joan Griffin, an attorney with the Rockville, MD, company, said that construction has already begun. Meanwhile, the NJ Department of Health is finishing up its study of birth defect rates in Vernon during the years following construction of the satcom stations in the 1970s. The investigation began early this year at the urging of Citizens Against the Tower, a community group opposing any additional RF/MW sources in the area (see *MWN*, December 1982).

Cellular Mobile Phone Service Begins... Ameritech Mobile Communications Inc. became the first company to offer cellular mobile phone service with the start-up of its Chicago-area system last month. Similar systems will open in other major cities soon, each with the capacity to service thousands of car phones rather than the hundreds now in use. Through a network of low-power transmitters, cellular technology allows the same frequency to be used simultaneously by drivers in different areas. Though this technology provides an efficient way to utilize the limited spectrum available for mobile communications, the FCC has warned there may be some tradeoffs. In its August 1983 report, *Future Private Land Mobile Telecommunications Requirements*, the commission's Private Radio Bureau states that call quality may suffer from the low signal strengths of network transmitters and that co-channel and adjacent channel interference may limit the capacity of cellular systems. For the present, however, any big city resident with $3,000 for a mobile phone will be able to make high quality calls

while on the road. A limited number of copies of the FCC's report are available from its Office of Public Affairs, Room 207, 1919 M Street, NW, Washington, DC 20554, (202) 254-7674.

COMPATIBILTY & INTERFERENCE

FCC Survey of RF Device Compliance... The FCC has found a small improvement in the number of RF devices that meet its RFI regulations. In the last six months, the agency has sent its engineers to 144 retail stores in more than 50 cities across the country to inspect computers, walkie-talkies, cordless phones, TVs, video games and other RF-emitting equipment. The survey of 1,746 devices found that 31 percent of computer equipment and 18 percent of coin-operated video games were improperly labeled and thus in violation of commission rules. Nine percent of the devices had no label at all, indicating they did not meet FCC emission limits. The FCC considers these results "disturbing," but is looking at the bright side because they represent a four percent improvement over last year's survey results. Joseph Casey, chief of the FCC Field Operations Bureau's Inspections and Investigations Branch, promises to continue his efforts to force compliance, levying "substantial" fines when necessary.

Green Light for Radio Marti... Congress has approved and the President has signed the "Radio Broadcasting to Cuba Act." It authorizes the creation of Radio Marti within the US Information Agency's Voice of America (VOA), to broadcast "accurate, objective and comprehensive news" to Cuba. Reagan signed S.602 into Public Law 98-111 on October 4. The compromise measure, which emerged after nearly two years of controversy, requires Radio Marti to use VOA's AM frequencies, primarily 1180 kHz. Will Cuba respond by trying to jam Radio Marti, as broadcasters have long feared? If so, the law allows the new station to lease time from other AM stations to broadcast over their frequencies. Also, the government can compensate station owners for losses due to interference from Cuba. For more information, see Senate Report No. 98-156, June 21, 1983, available from the Senate Document Room, Washington, DC 20510.

Resources...NBS has published *A Method to Quantify the Radiation Characteristics of an Unknown Interference Source*, (TN 1059), which describes the theory and experimental details for making measurements with a transverse electromagnetic (TEM) cell. A copy is available for $4.75, prepaid, from the US Government Printing Office, Washington, DC 20402. Order No. 003-003-02441-4....The Radio Technical Commission for Aeronautics (RTCA) Special Committee No. SC-148 on "Airborne Radio Communications Equipment Operating Within the Radiofrequency Range 117.975-137.000 MHz" plans to discuss ways of mitigating FM interference to airborne communications devices at its October 26-28 meeting....When power lines are built near AM radio broadcast antennas, large currents may be induced on the line. These can re-radiate a field and cause a major change in the antenna's radiation pattern. A group of Canadian reseachers explore ways of minimizing these interactions by adding "detuners" to the power line to reduce the re-radiated field. They detail such corrective measures in a paper in the August issue of *IEEE Transactions on Electromagnetic Compatibility*....Tecknit has published an *EMI Shielding Design Guide*, which is available for $10.00 from the company at 129 Dermody St., Cranford, NJ 07016, (201) 272-5500.

INTERNATIONAL

Australian Union Group... The Occupational Health and Safety Unit of the Australian Council of Trade Unions and the Victorian Trades Hall Council (ACTU/VTHC) has issued *Guidelines on Health Hazards of Electromagnetic Radiation*, a consultative document (Health and Safety Bulletin No. 31) with recommended exposure standards for ELF, RF/MW, IR, visible, UV and laser radiation. The unit finds that, "the claim that biological effects of EMR are exerted through heating mechanisms alone is without foundation, and therefore any standards based on these thermal effects alone offer no protection against cancer, genetic effects or cataracts of the eye." It advocates a preventive approach to radiation hazards and endorses a policy that exposures "should be reduced to the lowest levels technically achievable." Specifically, the unit recommends maximum exposures of 500 V/m for 0-100 Hz and 100 uW/cm^2 for 100 Hz-300 GHz. For IR and visible radiation the limits are 1 mW/cm^2. In addition, it advocates an emission standard of 1 mW/cm^2 for all new radiation emitting equipment (measured at 5 cm). The document is now circulating among affiliated unions for comment. According to the unit's research officer, Dr. John Matthews, a formal ACTU/VTHC policy will be adopted within six months to "guide unions in their negotiations with employers to reduce workers' exposure to EMR." (In August 1982, the Standards Association of Australia (SAA) proposed occupational exposure standards for RF/MW radiation (30 kHz-300 GHz) identical to those adopted by ANSI in 1982 and suggested limits for the general public a factor of ten lower than ANSI's. ACTU criticized the SAA proposal in comments filed this spring.) The ACTU-VTHC unit went through a similar consultative process with its policy for *Screen-Based Equipment*. A proposal for VDTs and related equipment was issued in May 1982 and a final policy statement was released in March 1983 (Health and Safety Bulletin No. 26).

New Association and Institute... The *Association for Biomedical Applications of Electromagnetism* has been formed in Milan, Italy, to promote scientific research on the bioeffects and medical applications of EM fields. ABAEM is planning its first congress, *Biological Effects and Therapeutic Applications of ELF Electromagnetic Fields*, to be held in Venice, February 23-25, 1984. For further information, contact the association's vice-president, Dr. Luigi

Zecca, Via Gentilino 9/a, 20136 Milan, Italy....Dr. Richard Bentall has set up the *Institute of BioElectrical Research* in Peebleshire, south of Edinburgh, Scotland. Bentall said in an interview that the non-profit institute will investigate the effects of EM fields on *all* living systems. For instance, he is interested in horticultural research: the effects on barley and other food crops. Bentall is also concentrating on soft tissue medical applications, such as the healing of wounds and burns. Contact: Bentall, Director, IBER, Romanno House Farm, Romannobridge, West Linton, Peebleshire EH46 7BY, United Kingdom.

MILITARY SYSTEMS

Project ELF... The last witness, Dr. Robert Becker, testified at the Project ELF trial in Wisconsin on October 19 and the attorneys for the state and the navy are now completing their final written arguments. A decision on whether the navy will have to prepare a new environmental impact statement (EIS) will come after November 21 when the Wisconsin Attorney General files his last brief. Some observers expect the decision to be handed down in January. On October 19, Judge Barbara Crabb denied a preliminary injunction, which would have stopped the navy from beginning construction on the ELF antenna until she issued a ruling. The judge found that the state would not be irreparably harmed if the work gets under way, but she warned the navy would be building at its own risk....The navy has released its environmental impact assessment (EIA) for construction of the ELF's Michigan facility in Dickinson and Marquette Counties. It deals primarily with the installation of the antenna lines and not their operation because the navy argues that it has continuously reviewed new scientific information on ELF propagation since the release of its 1977 EIS, and has concluded that "there is no credible evidence of adverse effect to human health or the environment." A limited number of copies of the EIA are available from Capt. R.L. Koontz, PME 110E, Naval Electronic Systems Command, Washington, DC 20363, (202) 692-8871.

MM Waves Setback... The US Air Force has cancelled its WASP millimeter wave, air-to-ground guided missile program. The move, requested by the Senate Armed Services Committee, is seen as a setback for the application of millimeter waves. As one expert put it, the market for millimeter wave technology is small and any such cancellation will hurt its development. An air force spokesman said that the Wide Area Anti-Armor Munitions (WAAM) program, designed to improve the ability of aircraft to destroy tanks, will move forward. The WASP missile was only one of a number of WAAM concepts. The WASP was being developed by Hughes Aircraft Co.'s Missile Systems Group, which is also working on a smaller missile with millimeter wave radar for the army's multiple lauch rocket system. No other air force weapon system using millimeter waves is as advanced as WASP, but *Aviation Week* reported on October 3 that a mock-up of the Tactical Avionics Low-Level Navigation and Strike (TALONS) millimeter wave radar was shown at the recent Air Force Association Convention. This project is being developed by United Technologies' Norden System for both the air force and the army.

POWER LINES

Epidemiological Studies Chosen by NY... The New York State Power Lines Project has signed contracts for two epidemiological studies on the relationship between alternating magnetic fields (AMFs) and cancer rates (see *MWN*, September 1983). Dr. David Savitz of the University of Colorado in Denver will investigate the incidence of childhood cancer and its possible association with AMFs in a project modeled after Dr. Nancy Wertheimer's work. Dr. Lowell Sever of Battelle Pacific Northwest Labs in Richland, WA, will investigate adult myelocytic leukemia and AMFs. Approximately $700,000 is budgeted for the studies. Copies of the final study proposals are available for 25 cents per page from Michael Rampolla, Power Lines Project Administrator, New York State Department of Health, Center for Laboratories and Research, Empire State Plaza, Albany, NY 12201, (518) 474-7888.

VDTs

Ohio Legislation...A bill that would set health and safety standards for VDTs has been introduced in the Ohio General Assembly. This brings to five the number of states with VDT legislation pending (New York, Oregon, Massachusetts, Illinois and Ohio). Maine and Connecticut passed bills earlier this year (see *MWN*, June 1983). The Ohio bill (No. 552), introduced October 14 by State Representative Barbara Pringle, would require adjustable, flexible work stations, measures to reduce glare, regular thorough eye examinations for operators and metal shielding of terminals to block radiation emissions. Also included are regular rest breaks, daily limits on the time spent operating a VDT, the right to non-VDT work during pregnancy and a prohibition against using terminals to monitor productivity or measure work performance of individual operators. Pringle says she is most concerned about reported pregnancy problems. The legislation, which would affect public and private employers in the state, is not likely to be acted on this year. Copies of the legislation are available from Rep. Pringle, Ohio House of Representatives, Columbus, OH 43215, (614) 466-6107.

International... The Canadian Labor Relations Board (CLRB) has rejected the request of a pregnant VDT operator for alternative work. Canadian union representatives are concerned that the decision could set a precedent, reversing a trend that started when employees of Bell Canada and members of the Ontario Public Service Employees Union (OPSEU) won the right to non-VDT work during pregnancy (see *MWN*, April 1981 and September 1982, respectively). Jean Sibley, an employee of Atomic Energy of Canada (AEC), claimed that VDT use placed her in "imminent danger" during her pregnancy, qualifying her for protection

(continued on p.11)

FROM THE FIELD

Last June, Dr. Robert O. Becker wrote to the Food and Drug Administration (FDA) to express his apprehension over the growing use of medical devices that apply direct currents (DCs) and pulsed electromagnetic fields (PEMFs) to stimulate bone growth. Reprinted below is an edited version of Becker's letter. Until his retirement in 1981, Becker was a research professor at the SUNY Upstate Medical Center in Syracuse, NY, and chief of orthopedic surgery at the Syracuse VA Hospital. He is the editor of Mechanisms of Growth Control *(1981), and the author, with Dr. Andrew Marino, of* Electromagnetism and Life *(1982).*

When contacted by Microwave News, *Dr. Alan Andersen, the deputy director of the Office of Standards and Regulations at FDA's National Center for Devices and Radiological Health, said that the agency was preparing a response to Becker.* Microwave News *will publish FDA's reply in a future issue.*

Meanwhile, we invite all interested parties to comment on Becker's letter.

Bone has been the one tissue most extensively studied from the point of view of its electrical properties and its growth response to electromagnetic fields. The response of bone to mechanical stress (Wolff's Law) has been ascribed to its innate piezoelectric properties [1,2], and the healing of fractures has been related to electrical properties common to regenerative growth in general [3,4].

When bone growth devices were first approved, it was assumed that, because of its unique properties, bone would be the only tissue responding to such electrical parameters.

The DC devices (eg, Zimmer's and Telectronics'), which use cathodes implanted at the treatment site, were intended to duplicate the naturally occurring electrical potentials observed during fracture healing. It was postulated that they would stimulate the cell populations required to form new bone. However, neither the responsible cell lines (periosteal, endosteal or marrow) nor the cellular mechanisms involved were identified with precision. Literature reviews [5,6] indicate that the DC devices produce de-differentiation of some marrow with subsequent re-differentiation into bone. This is a duplication of a portion of the natural fracture healing sequence.

The PEMF devices (eg, Electrobiology's [EBI] external coil system) operate in two distinct "modes" [7] each with a highly specific field pulse and a corresponding specific induced current pulse. No claims were made for direct growth stimulation; one mode was claimed to produce increased fibrogenesis and the other to produce efflux of calcium ions. Acting in concert they purport to form new bone [8]. The magnetic field is considered to be free of biological activity [9]. Recent evidence indicates that both modes have identical effects [10].

Both DC and PEMF devices expose tissue other than the target bone to the active stimuli. The Zimmer unit exposes the greatest amount by virtue of the bulk conduction of the current between the implanted cathode and the remote surface anode. The EBI device generates a magnetic field that penetrates all tissue between the coils and, by virtue of the fringing field, a considerably greater bulk although at diminished strength. The Telectronics device exposes the least amount of tissue because the implanted electrodes are closer together, although the current density is considerably greater than with the other devices.

When the FDA approved these devices, there were no studies on the effects of electrical currents or magnetic fields on embryonic growth and development or malignant growth. Evidence obtained over the past few years indicates that both electrical currents and magnetic fields have direct cellular effects which are, to a certain extent, dependent upon the type of cells exposed and their functional state. Neither effect is limited to bone or bone forming cells.

Direct electrical currents at levels obtainable within the bulk transmission area of the clinical devices (360 nA) increase the mitotic rate of human fibrosarcoma cells (HT 1080) *in vitro*, by a minimum of 300 percent [11].

The action of time-varying magnetic fields in general, including the specific pulses of the EBI device as well as simple ELF and VLF sine waves, can now be ascribed to a stimulation of mitotic activity [12]. The effect can be produced by magnetic fields as low as the Earth's (0.5 gauss) [13]. The magnetic field itself and not the induced current has been identified as the responsible agent [13,14]. There is evidence that RF frequencies modulated at ELF frequencies have identical effects [15].

Time-varying magnetic fields of similarly low strengths have been shown to induce severe embryological abnormalities in chick embryos [16]. This report has not yet been substantiated in detail, but another paper has indicated the production of such abnormalities in chick embryos exposed to PEMFs and incubated at a slightly higher than normal temperature or subjected to relatively minor surgical trauma [17]. An enhancement of mitotic activity of human leukemia cells by time-varying magnetic fields of similar strength and frequency has also been reported [18].

It should be noted that a number of retrospective epidemiological studies have indicated a higher than normal incidence of leukemias in individuals occupationally exposed to electromagnetic fields (primarily 60 Hz) [19], and a number of clusters of fetal abnormalities have been reported in female workers using VDTs [20].

It is evident that the exact mechanisms of action of DCs and PEMFs are different from originally proposed and require further evaluation. It is also evident that both modalities may have the capacity to enhance malignant growth. While it has not been demonstrated that either modality has a direct carcinogenic activity, the enhancement effect upon malignant cells could be considered to "tip the scales" in favor of such processes over the normal immunological resistance factors, thus encouraging the growth of small areas of malignant or pre-malignant transformation that otherwise would be destroyed.

A number of reports indicate a prolongation of survival times in animals with implanted tumors and treated with PEMFs [21]. This effect, however, is ascribable to the well established activation of the stress response system by whole-body exposure to time-varying magnetic fields [22]. In fact the most recent study states that such activation of the immune system is the mechanism responsible for the prolongation of survival [23].

I am aware that every device evaluation must involve a risk-benefit analysis. The ubiquitous presence of time-varying ELF magnetic fields in the environment is a necessary concomitant of our electrical power transmission systems, which are obviously of great social and economic importance. Such fields may be associated with a number of deleterious health effects and any risk-benefit analysis must await adequate epidemiological studies. At the present time, the use of time-varying magnetic fields in clinical therapy has no such constraints since there are other more conservative treatments available for the same conditions.

The therapeutic use of DCs and PEMFs as well as other electrically derived techniques holds great promise for many areas of medical practice. The ability to stimulate and control growth processes and to influence neuronal mechanisms has applications far beyond the stimulation of bone growth. The entire field must be thoroughly explored, mechanisms of action identified and side effects determined prior to widespread use. Unrestricted use of devices presently approved, or pending approval, could well result in an unfortunate incident thus delaying the ultimate application of the entire technology.

I urge that a moratorium be placed upon all clinical applications until adequate investigation has been completed.

Robert O. Becker, MD
Star Route, Lowville, NY 13367

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VDTs: Health and Safety —Order your copy of this 80-page indexed booklet with thorough coverage compiled from *Microwave News*. $6.95 including postage. PO Box 1799, Grand Central Station, New York, NY 10163.

UPDATES *(continued from p. 9)*

under the Canada Labor Code and permitting her to demand work away from a terminal. Her request for non-VDT work was denied by a federal Labor Canada safety officer, leading her to appeal to the CLRB. The board concluded that there is no "hard evidence" of pregnancy risks associated with VDTs and cited several studies which state that no risks exist. For this reason, it would be "unreasonable to so stretch" the Canada Labor Code to cover Sibley's request, the board ruled. Working at AEC's Glace Bay, Nova Scotia facility, Sibley was given a lead apron by AEC to wear while her appeal was pending despite prior protests by the company that there was no need for her to wear one. Copies of the board ruling (Decision No. 431, Board file 950-19) can be ordered from the Canadian Labor Relations Board, Ottawa, Ontario, Canada, K1A 0X8, (613) 996-9466....Some Australian journalists will now be entitled to take regular, 10-minute rest breaks from their VDTs after two hours' work as a result of recent arbitration, the US Newspaper Guild reports. The federal Australian Conciliation Commission ruled that 2,500 journalists at metropolitan daily newspapers can take paid breaks from their terminals as of September 1, but employers may assign other work during these periods. In emergencies, the commission said, terminal users can work no longer than two-and-a-half hours without a rest period.

Resources...A report on Swedish union responses to VDT and other work environment issues has been prepared by Dr. Olov Ostberg, a visiting scientist at NIOSH in Cincinnati. *Work Environment Issues of Swedish Office Workers: A Union Perspective,* will be included in a book scheduled for 1984 publication. Ostberg credits Swedish unions, notably TCO, the Central Organization of Salaried Employees, with primary credit for the Swedish Work Environment Act of 1977 and a new federal ordinance that will require ergonomically correct viewing conditions and individualized visual aids for workers beginning January 1. Ostberg emphasizes ergonomics as the "predominant" cause of all occupational diseases. His paper will appear as a chapter in *Human Aspects in Office Automation,* to be published by Elsevier (Amsterdam)....The VDT telephone hotline operated by 9 to 5, National Association of Working Women, closed November 1 after receiving more than 5,000 calls (see *MWN,* June 1983). The Cleveland 9 to 5 affiliate has announced that it will establish a local hotline to provide information and resources....Local 925 of the Service Employees International Union (SEIU, AFL-CIO) has published model language for unions interested in including VDT provisions in their contracts. Sample wordings are provided in nine areas including work breaks, workstation design, employer-paid eye examinations and long-term study of the health effects of VDTs. Requests for copies should be directed to District 925, SEIU, AFL-CIO, 2020 K Street, NW, Washington, DC 20006, (202) 452-8750.

Please Note
***Microwave News* has a new telephone number: (212) 725-5252.**

OSHA *(continued from p.1)*

Auchter's determination was reached informally, according to a series of interviews with agency officials, all of whom asked that their names not be used. RF/MW radiation was not deemed important enough to warrant further attention. Other options, such as adopting the 1982 American National Standards Institute (ANSI) RF/MW exposure limits, were considered but rejected.

Voluntary Standard To Remain

OSHA's current 10 mW/cm^2 health standard is voluntary and has been ruled unenforceable by the courts (see *MWN*, April 1982). The agency used to have another option: enforcing standards set by other organizations, such as ANSI, under the Occupational Safety and Health Act's general duty clause, Section 5(a)(1), which requires that every work place be free of recognized hazards. But in March 1982, Auchter ruled that OSHA inspectors cannot enforce voluntary standards under the general duty clause (see *MWN*, April 1982). As a result, OSHA stopped monitoring worker exposure to RF/MW radiation.

In May 1982, OSHA proposed deleting its voluntary standards, including the one for RF/MW radiation (47 *Federal Register* 23479, May 28, 1983). According to the October regulatory timetable, a final rule for these deletions is scheduled for November 1983. OSHA's Graybill said that while this deadline might still be met, the rule is more likely to appear in December.

Microwave News has learned that OSHA does not plan to delete the 10 mW/cm^2 RF/MW standard. Informed sources said that the RF/MW standard is not listed among the voluntary standards to be scrapped in the current draft of the final rules. Graybill would neither confirm nor deny this fact, but did say that OSHA rules should not be construed as final until they appear in the *Federal Register*.

If the 10 mW/cm^2 standard remains in the rules, OSHA inspectors will be barred from issuing citations for worker overexposure to non-ionizing radiation.

Joe Velasquez, the executive director of the Worker Institute for Safety and Health said that he was not surprised by this development; "It fits a pattern by the Reagan Administration to weaken worker protection."

ANPRM Never Published

At the end of last year, the OSHA staff prepared an advanced notice of proposed rule making (ANPRM) for a new RF/MW standard for review by the agency's senior management (see *MWN*, October 1982). The proposal was still under consideration as late as last spring, but it was never approved or published in the *Federal Register*.

The National Institute for Occupational Safety and Health (NIOSH) has been preparing a criteria document for RF/MW radiation since the mid-1970s. The document, which would be the basis for an OSHA standard, has suffered a series of setbacks and is still not finished. According to a NIOSH staffer, a review draft of criteria document should be completed by the end of 1983.

SHORT COURSES

December 5-6: ***EMI Workshop,*** Philadelphia, PA. Fee: $575. Contact: R&B Enterprises, 20 Clipper Road, W. Conshohocken, PA 19428, (215) 825-1960.

December 5-9: ***Microwave Circuits: Theory & Applications,*** Sunnyvale, CA. Fee: $850. Contact: Continuing Education Institute, Suite 1000, 10889 Wilshire Blvd., Los Angeles, CA 90024, (213) 824-9545 or (301) 596-0111.

December 5-9: ***EMC Design & Measurement for Control of EMI,*** Fee: $995. Contact: Don White Consultants, Inc., (DWCI), State Route 625, PO Box D, Gainesville, VA 22065, (703) 347-0030.

December 6: ***Electrostatic Discharge Control Seminar,*** Phoenix, AZ. Fee: $275. Contact: EMXX Corp., 6706 Deland Drive, Springfield, VA 22152, (703) 451-4619.

December 6: ***Hospital Electrical Safety,*** New York, NY. Fee: $180 (AAMI members), $200 (others). Contact: Association for the Advancement of Medical Instrumentation (AAMI), Suite 602, 1901 North Fort Myer Dr., Arlington, VA 22209, (703) 525-4890.

December 6-9: ***Antenna Measurement Techniques,*** Atlanta, GA. Fee: $660. Contact: Technology Service Corp. (TSC), 8555 16th St., Suite 300, Silver Spring, MD 20910, (800) 638-2628.

December 6-9: ***Radar Systems Engineering,*** Fort Walton Beach, FL. Fee: $660. Contact: TSC, see December 6 above.

December 12-16: ***Electromagnetic Interference and Control,*** Washington, DC. Fee: $875. Contact: Continuing Engineering Education, George Washington University (GWU), Washington, DC 20052, (800) 424-9773.

December 14-15: ***EMI Diagnostics and Fixes,*** Philadelphia, PA. Fee: $635. Contact: DWCI, see December 5 above. Repeated ***January 25-26:*** San Diego, CA.

1984

January 9-13: ***Fundamentals of Radar Cross Section,*** St. Cloud, FL. Fee: $695. Contact: Southeastern Center for Electrical Engineering Education (SCEEE), Central Florida Facility, 1101 Massachusetts Ave., St. Cloud, FL 32769, (305) 892-6146.

January 17: ***EMC: The FCC Means Business,*** San Francisco, CA. Fee: $595. Contact: Carol Clark, McGraw-Hill Seminar Center, 331 Madison Avenue, Suite 603, New York, NY 10017, (212) 687-0243. Repeated ***April 3:*** Boston, MA.

January 23-27: ***Microwave High-Power Tubes and Transmitters,*** Los Angeles, CA. Fee: $875. Contact: GWU, see December 12 above.

January 31-February 2: ***Millimeter Wave Systems & Technology,*** Atlanta, GA. Fee: NA. Contact: Dept. of Continuing Education, Georgia Institute of Technology (GIT), Atlanta, GA 30332, (404) 894-2547.

February 8-9: ***Microwave Devices & Sources,*** Atlanta, GA. Fee: NA. Contact: GIT, see January 31 above.

February 16-17: ***Grounding, Bonding & Shielding,*** San Diego, CA. Fee: $625. Contact: GWU, see December 12 above. Repeated ***April 9-10:*** Washington, DC.

February 21-24: ***Microwave Solid State Devices and Circuits,*** Los Angeles, CA. Fee: $895. Contact: UCLA Extension Short Course Program, PO Box 24901, 6266 Boelter Hall, Los Angeles, CA 90024, (213) 825-1047.

February 27-March 2: ***Spread Spectrum Systems and Interference Rejection Techniques,*** Los Angeles, CA. Fee: $895. Contact: UCLA, see February 21 above.

March 5-7: ***Planning & Implementing an NMR Imaging Facility,*** Washington, DC. Fee: $695. Contact: GWU, see December 12 above.

March 12-16: ***Radiowave Propagation for Communications Systems Design,*** Orlando, FL. Fee: $875. Contact: GWU, see December 12 above.

March 15-16: ***Lightning Protection,*** Orlando, FL. Fee: $625. Contact: GWU, see December 12 above.

March 19-23: ***Flat-Panel and CRT Technologies,*** Los Angeles, CA. Fee: $895. Contact: UCLA, see February 21 above.

MICRO WAVE NEWS

Vol.IV No.9 A Monthly Report on Non-Ionizing Radiation November 1984

INSIDE...

HIGHLIGHTS pp.4-5

FAA Okays Use of Portable Computers In Flight

Cataract Risks

Navy Review of EMP Radiation: Bioeffects and EMI

FROM THE FIELD pp.6-8

Site Visit Report on Dr. Wendell Winters's ELF Research, with Winters's Reply

FDA Draft Guidelines for Occupational Exposures from RF Dielectric Sealers and Heaters

UPDATES pp.9-12

IEEE Spectrum Imbroglio □ Change in FCC RFI Sampling Program □ More on DNA Resonances □ San Diego Adopts ANSI Standard □ MW Oven Sales Boom □ VLF Bioeffects Study □ Preparing for Radio Marti □ VDT Legislation □ Winters Replication Study □ EMPRESS II Hearings □ Secure, Airborne and Cordless Telephones □ Medical Applications Resources □ VDT Pregnancy Risks Meeting □ IMPI and AIMC Proceedings Available □ and more...

Conferences p.12

Short Courses p.12

Classifieds p.7

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.

Extremely Weak Magnetic Fields Affect Behavior

Extremely weak magnetic fields can have a profound effect on the behavior of rats, according to new experimental findings at a Navy research lab. The results have generated a great deal of excitement because the observed effects were *predicted* by a theoretical model and because the applied fields were of such low intensity.

The model assumes that biologically important ions undergo cyclotron resonances when influenced by static and oscillating magnetic fields. The results reaffirm the pivotal role played by the Earth's magnetic field in bioelectromagnetic interactions.

The new findings are the result of a collaboration between Dr. Abraham Liboff, a physicist at Oakland University in Rochester, MI, and Drs. John Thomas and John Schrot, psychologists at the Naval Medical Research Institute (NMRI) in Bethesda, MD. Using predictions from a model devised by Liboff, Thomas and Schrot found that rats exposed to 60 Hz fields of less than 100 milligauss in a static magnetic field of 270 milligauss displayed impaired timing discrimination. Thomas told *Microwave News* that the results constitute "one of the most interesting developments to come along in a long time."

Thomas is not alone in this assessment. In an October 15 site visit at NMRI for the New York State Power Lines Project, Dr. Mike Marron of

(continued on p.2)

State Power Line Actions

Several state and local governments are currently addressing power line health and safety issues. Although it is likely that only Montana will adopt power line radiation limits this year, there is a clear trend toward government intervention on behalf of a concerned public. The following status reports summarize developments in Montana, Michigan, Virginia and Texas.

Montana

The Montana Department of Natural Resources and Conservation held three hearings in October on its proposed overhaul of the state's Major Facility Siting Act rules. Proposed Rule CXIV sets a 1 kV/m limit for the electric field at the edge of a right-of-way (ROW) in residential or subdivided areas, measured one meter above the ground. Noise levels would be limited to 50 dB at the edge of the ROW. A landowner can waive these requirements, but the electric field under the line will not be permitted to exceed 7 kV/m at road crossings (see *MWN*, July/August 1983).

According to Paul Stolen in the department's Energy Division, no new technical data challenging the state's position were submitted during the hearings. He expects that the state's Board of Natural Resources will adopt the rules before Christmas. "After looking at the comments received," he said in a telephone interview, "there should be no problem making the Christmas deadline."

(continued on p.3)

the Office of Naval Research called the demonstration "stunning."

Marron went on to report that the new effect "provides strong support for the hypothesis that static magnetic fields, similar in strength to the Earth's magnetic field, can dramatically alter the response of a living organism to alternating electromagnetic fields."

In a number of interviews, researchers who had already learned of the Liboff-Thomas findings expressed similarly enthusiastic opinions.

Cyclotron Resonances

Liboff calculated the resonant frequencies of ions under conditions of cyclotron resonances for various values of a static magnetic field. According to his model, lithium ions absorb 60 Hz radiation in a static magnetic field of 270 milligauss (about half the Earth's field).

Thomas then exposed rats under these conditions and found what he called "fairly remarkable changes in behavior" for 60 Hz magnetic fields of less than 100 milligauss. Indeed, Thomas said he found statistically significant alterations in behavior for "almost immeasurable" magnetic fields.

According to Liboff, lithium ions affect the functioning of neurotransmitters, especially epinephrine (adrenaline), and therefore any changes in lithium concentrations in and around cells can translate into changes in behavior.

The effect appears to be transient. The rats exhibited the observed, altered behavioral patterns an hour after a 30-minute exposure, but returned to normal 24 hours later.

When asked about the reliability of the behavioral test, Thomas said that the timing discrimination protocol has been used to test the effects of drugs for more than 20 years and is very reliable.

Liboff and Thomas have also exposed rats to the 60 Hz field without modifying the Earth's magnetic field, to a reduced static magnetic field without the alternating magnetic field and to baseline (control) conditions. For each of these exposure conditions, they found no effects, indicating that a resonance phenomenon is present.

(A charged particle moving with an initial velocity in a magnetic field will experience a force perpendicular to the magnetic field and the line of motion. As a result, the ion will move along a circular or helical path characterized by a specific angular frequency and can absorb electromagnetic energy at that specific frequency, which is a function of the ion's charge-to-mass ratio and the magnetic flux density. That frequency is known as the cyclotron resonance frequency.)

Through or Near the Membrane

Liboff's original model assumes that ions make their way into a cell by crossing the membrane along helical structures. Thus, the ions travel in helices and, he concludes, have distinctive cyclotron resonances.

When Liboff presented his hypothesis at a NATO workshop in Erice, Italy in September, three general types of questions were raised: (1) Do such helical structures actually exist? (2) If the ions are hydrated, as some experts maintain, will the weight of the water molecules affect the crucial charge-to-mass ratio which determines the cyclotron frequency? (3) If the ions collide as they go through the membrane, how will such interactions affect the ion motion and therefore possible resonances?

While none of these questions pose insurmountable obstacles to Liboff's model, they do suggest that more research is needed if the model is to gain widespread acceptance.

Some researchers believe that you do not have to invoke helical pathways to measure cyclotron resonances. It may be that the resonances stem from the movement of ions on the surface of the membrane.

Whatever the physical mechanism, Liboff's hypothesis on the presence of cyclotron resonances yielded the precise combination of static and alternating magnetic fields that caused distinctive changes in the behavior of live animals. As Dr. Mays Swicord of the Food and Drug Administration said in an interview: "Is it a coincidence? I think there is some relationship here."

Blackman's Data

Dr. Carl Blackman of the Environmental Protection Agency invoked the concept of cyclotron resonance as a possible explanation for his experimental results on the efflux of calcium ions from brain tissue as a function of the static and alternating fields at last summer's Bioelectromagnetics Society meeting in Atlanta (see *MWN*, September 1984). At that time, he was unwilling to commit himself to this mechanism, however. Nor will he now.

At the end of October, Blackman told *Microwave News:* "Liboff's and Thomas's experimental results once again demonstrate the pivotal importance of the Earth's magnetic field, but it is still too early to bank on one mechanism to explain them. As far as I am concerned, we have a fascinating phenomenon in need of an explanation."

Equipment Limitations

Thomas ran the experiments with equipment that was designed for another project contracted by the New York State Power Lines Project. Thomas and Liboff were thus unable to change the frequency of the alternating magnetic field; they could only use a 60 Hz field with a partial ability to vary the static magnetic field.

Because of these limitations, Thomas and Liboff could not alter the Earth's magnetic field sufficiently to test whether potassium and sodium ions exhibit similar cyclotron resonances. Given the biological importance of these elements, they are natural candidates for future studies.

Meanwhile, theoreticians will be busy trying to explain how a force that is some 12 orders of magnitude smaller than natural, thermal interactions can have such profound effects on a living system.

State Power Line Actions (continued from p.1)

Michigan

State Representative Ken DeBeaussaert has drafted legislation to set limits for radiation along power line ROWs in Michigan. The brief measure instructs the state's Public Service Commission (PSC) to develop a standard to mitigate shock, fire and interference hazards as well as "any other scientifically recognized effect associated with transmission lines."

DeBeaussaert will introduce the bill soon after the legislature reconvenes on November 13, but because of his defeat in the November elections, the bill will probably have to be reintroduced next January by co-sponsor Representative Lynn Jondahl.

A power plant siting bill introduced by DeBeaussaert and others on July 3 is also unlikely to see action. House Bill 5676 would require a utility planning to build a plant to obtain a certificate of need from the state Energy Administration. The utility would then have to obtain a certificate of environmental compatibility from the state Department of Natural Resources. Jondahl has introduced similar legislation for several years.

A much more limited measure authorizing the PSC to issue certificates of need, Senate Bill 815, was introduced earlier this year by State Senator Nick Smith.

Public concern in Michigan focuses on the Detroit Edison Company's planned 345 kV Yukon-Saratoga line. The utility has locked horns with several townships, including Columbus, Richmond and Armada, over local power line ordinances. Columbus settled with the utility out of court, Richmond's ordinance was overturned in a summary judgment and the utility's suit against Armada is just getting underway. Although some of the ordinances include radiation limits, this is not a key litigation issue.

Carroll County, VA

In a case similar to those brought in Michigan, the Virginia Supreme Court agreed in September to decide whether Carroll County has the right to establish requirements for ROWs. In September 1983 the Appalachian Power Company (APCO) successfully appealed the county's June 1982 ordinance to prohibit permanent residences within 600 feet on either side of a 765 kV power line. A lower court ruled that the county impinged on the authority of the State Corporation Commission. The utility had already purchased a substantial amount of property for a narrower ROW for its planned 72-mile Jacksons Ferry-Axton line. The county believes it has the right to impose rules to protect public health and safety.

Virginia

The joint legislative subcommittee, set up in March under Senate Joint Resolution No. 26 to determine whether power line health and safety regulations are needed in Virginia, will hold the last of three scheduled hearings on November 16 in Richmond (see *MWN*, June and July/August 1984). Under the chairmanship of State Senator Madison Marye, the group is authorized to draft legislation. Citizens groups are opposing construction of APCO's 765 kV line and are pushing for regulations.

Copies of the minutes for hearings held on August 9, October 12 and November 16 may be requested from Terry Mapp of the state's Division of Legislative Services, PO Box 3-AG, Richmond, VA 23208, (804) 786-3591.

Texas

The Public Utility Commission (PUC) of Texas has extended its review of potential health risks from a proposed ±400 kV DC power line. The September 14 decision is likely to delay a final ruling on whether to approve the Walker-Matagorda line for at least a year as more hearings are held.

On June 21, a PUC hearing examiner recommended that certification be denied because of potential health risks. Her findings were challenged by representatives of Central Power and Light Company, Houston Lighting and Power Company and Southwestern Electric Power Company, who argued that the PUC was overstepping its authority.

The state has grappled with power line health and safety issues in the past on a case-by-case basis. This is the first time it has had to evaluate a DC line, however.

Other Actions

Florida and New Jersey have also considered power line safety in the recent past. A 1983 amendment to Florida's statutes authorized the state Department of Environmental Regulation to establish public safety requirements for certain power line siting applicants (see *MWN*, July/August 1983 and July/August 1984). Toward that end, a study funded by state utilities is in progress under the chairmanship of Dr. H.B. Graves of Pennsylvania State University.

In New Jersey, the Commission on Radiation Protection has asked the federal Environmental Protection Agency to develop standards for power line radiation exposure. In addition to believing that uniform federal standards are desirable in general, the commission concluded this summer that the state does not have the resources to develop an informed standard. ●

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FAA Okays Use of Portable Computers In Flight

The Federal Aviation Administration (FAA) plans to issue rules clearly permitting passengers to use computers, calculators and electronic games in flight. The devices may not be used during takeoffs and landings, however, "to provide an extra margin of safety."

The FAA decision to issue a policy statement follows a year of study by the Radio Technical Commission for Aeronautics' (RTCA) Special Committee 156 on "Potential Interference to Aircraft Electronics Equipment from Devices Carried Aboard." Over the summer, in a memorandum prepared for RTCA SC156 members, Frank White, chairman of the RTCA committee, recommended the policy now adopted by the FAA (see *MWN*, September 1984).

So far, the FAA has only issued a press release announcing its decision, but the agency said that it will publish an "Advisory Circular" and new rules "to make it clear that computers, calculators and electronic games do not interfere with radio and navigation equipment."

The FAA will continue to prohibit the use of walkie-talkies, radio-controlled toys, portable televisions and AM-FM radios on aircraft because they are "proven sources of interference."

Indeed, there was a new report of electromagnetic interference at the last RTCA SC156 meeting in September. According to the minutes of the meeting, D.J. Tangney of United Airlines reported that a pilot of a Boeing 727, flying over southeastern Colorado, noticed a drifting of the plane's very high frequency omnidirectional radio range (VOR) needles. A check of the passengers revealed that one was using a Panasonic radio/cassette player-recorder. When the unit was turned off, the needles "corrected themselves." (United tried to buy the device but could not.)

The next RTCA SC156 meeting is scheduled for January 23-24 in Washington, DC.

Cataract Risks

Two recent papers, described below, shed new light on the susceptibility of the human eye to non-ionizing radiation.

Cataracts in Radio Linemen

Drs. F.C. Hollows and J.B. Douglas of the University of New South Wales in Australia have found an increase in posterior subcapsular cataracts among radio linemen exposed to radiation from radio and television towers as compared to controls with other occupations. Writing in the August 18 *Lancet*, they report that workplace exposures varied from 80 uW/cm^2 to 3956 mW/cm^2 in the frequency range from 558 kHz to 527 MHz.

The researchers note that there was a very small and statistically insignificant increase in nuclear sclerosis among the exposed workers as well. This type of lens opacity is often related to exposure to solar radiation.

Hollows and Douglas's report prompted a response from Dr. B. Hocking of Telecom Australia, published in the September 29 *Lancet*. Among other points, Hocking noted that the linemen worked for Telecom and that they may have worked with microwave frequencies up to 13 GHz.

Frey Reworks Appleton Data

Dr. Allan Frey of Randomline Inc. in Huntingdon Valley, PA, has reanalyzed the data presented in a 1972 paper by Drs. Budd Appleton and George McCrossan and found that, contrary to the original conclusion, there was a statistically significant increase in lens opacities among military personnel chronically exposed to microwave radiation.

In their paper, Appleton and McCrossan concluded that their study "does not support the assumption that cataracts which develop in personnel performing duties in the vicinity of microwave generating equipment are a result of microwave exposure," except for severe exposures (*Archives of Ophthalmology, 88,* 259, 1972).

Frey came to the opposite conclusion on the basis of the original data. He explains that he found three "fundamental faults" with the earlier work: (1) the exposed group most likely included people who had little or no exposure to microwaves; (2) the control group consisted of people working with equipment known to cause eye damage; and (3) Appleton and McCrossan did not do a statistical analysis of their data.

Frey reports that his new analysis reveals that "Appleton has a statistically significant difference between groups, with the microwave-exposed showing more lens opacities than would be expected by chance."

He goes on to note that, "When one considers that Appleton's study was set up in such a way as to minimize the possibility of showing microwave-induced lens opacities, the effect of the microwaves must be quite powerful."

Frey's paper has been submitted for publication.

Navy Review of EMP

Last month we reported on the potential impact of siting an electromagnetic pulse (EMP) simulator on the Chesapeake Bay near the Calvert Cliffs, MD, nuclear power plant. As a followup, details from the Navy's draft environmental impact statement (EIS) for the EMPRESS II facility regarding EMP biological effects and electromagnetic interference (EMI) are summarized below.

The Navy has concluded that radiation from EMPRESS II will have no biological effects on humans and is unlikely to affect birds or marine life. Bay area life will be monitored, however, when the simulator goes into operation in late 1986. The Navy also believes that the simulator's pulse will be too weak and the pulse rate too slow to create serious EMI problems.

Biological Effects

The draft EIS provides an interesting overview of EMP research, including health checks on approximately 600 workers conducted by defense agencies and their contractors in the 1970s. The largest study, encompassing approximately 400 workers, was conducted by Boeing Aerospace from 1970 to 1976. Much smaller studies were performed by

Bell Laboratories, the Air Force, the Navy, EG&G Inc., Science Applications Inc., Rockwell International, Physics International Co., Pulsar Associates Inc. and Avco. None of these surveys uncovered harmful effects.

Subtle EMP bioeffects were found in a small percentage of animal studies conducted in the late 1960s and early 1970s, all of which used extremely high intensity fields. For example, in studies for the Armed Forces Radiobiology Research Institute (AFRRI), W.D. Skidmore, S.J. Baum and coworkers found that the blood counts of rats were temporarily affected after exposure to 447 kV/m pulses for a 20-week period. These findings were dismissed as being either transient or insignificant.

Some temporary behavioral effects in animals were reported by F.G. Hirsch and coworkers at the Lovelace Biomedical and Environmental Research Institute. Behavioral changes in rodents, such as in level of activity and degree of heat stress, were also reported by W.C. Milroy and coworkers at the Naval Surface Weapons Center.

Present knowledge of potential effects of EMP on birds and marine life is limited. Very few studies have been done, so the EIS speculates on possible impacts based on other electromagnetic interactions such as interference with migration patterns.

The only defense agency standard for human EMP exposure is currently under review. According to the draft EIS, the Air Force occupational standard (AFOSH 161-9, October 10, 1978) of 100 kV/m — based on the old American National Standards Institute (ANSI) guidelines for other forms of non-ionizing radiation — is being reviewed "for possible significant downward revision." Both Bell Labs and Boeing established much lower in-house standards in the 1970s: the Bell limit varies from 1 to 5 kV/m, depending on the pulse repetition rate and Boeing's is "nearly comparable."

In the early 1970s, Boeing petitioned the Occupational Safety and Health Administration to promulgate an EMP standard to "assure that Boeing's duty to control employee exposures satisfied the employer requirements of OSHA Public Law 91-596."

The majority of comments on the Occupational Safety and Health Administration's (OSHA) 1974 proposal to set an EMP standard stressed that no standard should be issued, however, and OSHA shelved the proposal. The Navy states in the EIS that, "repeatedly, it was implied that an appropriate rationale for predicting EMP bioeffects was lacking." Further, it was noted at the time that an EMP standard would have to consider the possibility of non-thermal effects, which were not included in ANSI's deliberations.

Electromagnetic Interference

The Navy's evaluation of potential EMP-induced EMI covers cardiac pacemakers as well as communications equipment, computers and other electric or electronic systems.

In general, the Navy places the threshold for EMP damage to sensitive electronic/digital systems at 2.5 kV/m. The interference threshold for less serious disturbances is about 1.5 kV/m. These evaluations are in part based on observations of the effects caused by other simulators, as well as on laboratory tests.

The Navy cautions, however, that the current generation of electronic equipment may be more sensitive to EMPs than similar units produced only a few years ago because of the use of lower voltage (5 volts) digital logic circuits.

The Navy's specific examples of EMP EMI include televisions, AM/FM receivers and microcomputers. Several years ago, damage to a television and a short wave receiver was reported in a house where fields reached 5-6 kV/m. But in tests conducted for the Defense Nuclear Agency (DNA) in 1978, the lowest level for "sensitivity degradation" for a television was about 8 kV/m, with damage occurring above this level. According to the Navy, the DNA results are similar to those for military communications equipment.

Upsets were reported for digital systems such as word processors, desk top computers and peripheral equipment in buildings near the Naval Aircraft Vertical EMP Simulator II (NAVES II) at field intensities of 1.5 and 2 kV/m. A Hewlett-Packard series 9825 computer was among the affected units.

Interestingly, recent tests of an Apple II computer at the Army's Harry Diamond Laboratories revealed that EMPs may have a cumulative effect. An upset occurred only with the eleventh pulse of 10-13 kV/m radiation, and the computer's disk drive and an attached printer failed altogether after the twelfth pulse.

The Navy reports that more detailed information on EMP effects on small computers will be gathered by the Air Force Weapons Laboratory in upcoming tests of Radio Shack TRS-80 units.

The EIS describes a number of exposure situations for aircraft and aircraft communications facilities, none of which resulted in interference. For example, the control tower of the Albuquerque International Airport, which is 330 yards from the Vertically Polarized Dipole I (VPD I) simulator, was unaffected by EMPs ranging between 960 and 2000 V/m. And aircraft on a taxiway approximately 200 yards away from VPD I reported no problems in 1.75 kV/m fields.

The Navy believes its general threshold estimates apply to pacemakers. In the major EMP-pacemaker study, conducted by B.M. Jenkins and J.A. Woody for the DNA in 1978, none of the 40 units tested were affected at 1.35 kV/m. At a level of 5 kV/m, about 20 percent of the units suffered "temporary perturbations" but no permanent damage. It is generally acknowledged, however, that newer pacemakers are likely to be more susceptible to EMP.

Air Force tests showed that "single EMP exposures caused no catastrophic failures even at 50 kV/m." But the Air Force set an electric field limit of 300 V/m for repetitive pulses of two to one hundred pulses per second in unrestricted areas.

For further information on the draft EIS, contact Lt. Pietropaoli, Office of Information, Department of the Navy, Washington, DC 20350, (202) 697-5342.

Site Visit Report on Dr. Wendell Winters's ELF Research

On August 29, 1984, Drs. Jeffrey Trent of the University of Arizona and Ronald Buick of the University of Toronto visited Dr. Wendell Winters's laboratory at the University of Texas Health Science Center in San Antonio. Also present during the meeting were Dr. Michael Shelanski of New York University, the chairman of the New York State Power Lines Project scientific advisory panel, and Mr. T. McDermott of the Power Authority of the State of New York. (For background information on Winters's work see MWN, *April, September and October 1984 and* Updates, *p.11.) Reprinted below is the report submitted by Trent and Buick to the project, followed by Winters's October 9 reply to Michael Rampolla, administrator of the project. [All emphases in the text are in the originals.]*

Site Visit Report

Description:

Dr. Winters's laboratory efforts related to determining biologic effects of electromagnetic exposure are multiple, including analysis of antibody expression, immunologic features of canine hematopoietic cells, normal cell "transformation" and most recently, agar cloning. The purpose for this recent site visit was to review Dr. Winters's program solely in regard to the agar cloning studies performed in collaboration with Dr. Jerry Phillips of the Southwest Texas Cancer Research and Treatment Center of San Antonio (CRTC). Dr. Phillips declined to participate in the site visit, and neither he nor any representative of the CRTC was present for this review. The site visit followed an informal format, with Dr. Winters providing adequate data for review and answering all questions posed by the site visitors. *It can be stated categorically that Dr. Winters was fully cooperative with the site visit team.*

The basic experimental design applied by these investigators related to determining whether a significant and reproducible effect on agar clonogenicity occurred as a result of exposure to electric (E), magnetic (M) or electromagnetic (EM) fields. The investigators utilized agar clonogenicity in an apparent attempt to document changes in proliferative potential of established tumor cell lines. Dr. Winters's presentation provided detailed methodology of cell culture and EM exposure and the results of several of their current experiments. The site visitors also were provided with copies of Drs. Winters's and Phillips's published reports on this work (consisting entirely of abstracts to scientific meetings).

The data presented was primarily restricted to two different colon carcinoma cell lines (Colo 205 and Colo 320). [Although a single experiment on four different carcinoma cell lines also was presented (Hep 2, KB, MCF-7 and ZR-75).] The basic experimental design consisted of exposing tumor cell lines to E, M or EM fields with subsequent establishment of clonogenic potential in agar. The parameters varied included: 1) time of exposure, 2) dose of exposure, 3) cell concentration during exposure, 4) cell number plated and 5) colony size used as an endpoint. "Recloning" of several of the exposed populations was also performed and evaluated.

Critique:

Drs. Winters and Phillips have previously reported in abstract form the finding of a significant and "permanent" effect of low level EM fields on agar clonogenicity of human tumor cell lines. For numerous reasons presented below, it would appear that Drs. Winters and Phillips have prematurely reached a conclusion of significance from their preliminary data. Unfortunately, the area of electromagnetic field exposure has abounded in poorly designed and controlled studies which demonstrate "significant" biologic effects of treatment but which are irreproducible in independent laboratory tests. The present study would appear to fall in this category. With our poor knowledge of biophysical mechanisms underlying agar clonogenicity, and our equally imprecise knowledge of biophysical mechanisms of cell membrane and organelle structure and function, interpretations of treatment effects in this area and especially their biologic significance require considerable circumspection. The experiments of Drs. Winters and Phillips which were described at the site visit do not allow any definitive conclusions to be drawn with respect to the authors' central hypothesis, namely, that exposure to electromagnetic fields produces a significant alteration in agar clonogenicity. The reasons for this statement are manyfold and are provided below.

(a) Choice of Model

Disregarding any technical difficulties in accumulating data on agar clonogenicity, the choice of this endpoint as a marker of carcinoma cell behavior is problematic. If the experiments presented were in fact designed to assess tumor cell characteristics of importance to the *in vivo* situation, then the choice of agar clonogenicity of carcinoma cell lines as an endpoint is a bad one. At present, there is no established relationship between the ability of carcinoma cells to grow in agar culture and their ability to grow in xenografted host animals. Indeed there are many examples of aggressive transplantable tumors which cannot be induced to grow in semisolid culture. The reciprocal statement can also be made. Such a relationship (agar clonogenicity/tumorigenicity) does hold for fibroblastic tissue. Thus the experiments reported, if done properly, would allow statements about the phenotype of agar growth, but would not allow extrapolation to the *in vivo* growth of human carcinoma cells. The experiments might be better performed on a transformed fibroblast system in which there would be convincing evidence that agar clonogenicity does in fact correlate with *in vivo* tumor growth.

(b) Experimental Design

The data presented at the site visit did not allow any conclusions to be drawn even on the limited subject of the determinants of agar clonogenicity of human carcinoma cell lines. The major reason for this statement relates to the lack of reproducibility of the putative effects, a result caused in major part by an experimental design which varied multiple parameters in an apparently random fashion, not allowing direct comparison of separate experiments. For example, in the 27 experiments shown to us, the same combination of variables (field strength, time of exposure, cell line tested, cell concentration exposed, number of cells plated) was never used twice.

(c) Quality of Data

Of equal importance, the quality of the data presented at the site visit was poor. Since measurement of agar clonogenicity is known to be prone to artifact, the burden of proof of validity is clearly with the investigators. In the reviewers' opinion, Drs. Winters and Phillips have failed to demonstrate any effect of electromagnetic field exposure on the growth of their chosen cell lines. The basis for this conclusion is twofold:

(1) The statements by Dr. Winters that the majority of his data sets demonstrated a trend to increased clonogenicity after E or EM exposure are not justified. Only 2 of the 27 individual data sets we were shown would allow such a statement to be made with any statistical validity. When the "overall experience" is taken into account, the data demonstrated sufficient inherent noise to rule out any conclusion (positive or negative).

(2) The extent of the variability in the cloning efficiency of the

control cultures on a day-to-day basis is very disturbing. For example, both Colo 205 and 320 displayed a variance in plating efficiency (PE) over a ten-fold range on different days. There are a number of positive sources of artifact which might explain such variable behavior; (e.g., lack of linearity of colony growth with respect to cell number plated, cell clumping or general health of the cell cultures). Whatever the cause of the variability, when the postulated treatment effects are reported to be as small as sixfold, the fact that [tenfold] differences in control PE can be introduced in a random fashion clearly precludes the description of conclusions in a statistically-valid manner.

Conclusion

The unanimous consensus was that the experiments presented to the site visit team did not allow any definitive conclusion regarding either the positive or null effects of electromagnetic radiation on agar clonogenicity. Due to the inconsistency in the experimental design, it is impossible to state which variable(s) are the basis for the lack of observed reproducibility.

Winters's Reply

October 9, 1984

Dear Mr. Rampolla:

I am in receipt of the reports from you relating to the site visit of August 29, 1984.

There are a number of issues raised in these reports that do not reflect clearly the nature and quantity of the studies reviewed. Therefore, I would like to point out the following comments with specific reference to the report of the review by Drs. Trent and Buick.

Specifically commenting on (a) Choice of Model: We did not and have not raised the issue nor have we attempted to address the issue of extrapolating our *in vitro* studies into considerations of *in vivo* situations. Our discussions and objectives have been directed towards investigations of possible effects of EM exposure on a variety of structural and functional cellular parameters. The cancer cells selected have been well studied and characterized and they are ones with which we have had experience. Among the quantitative assays used, the cloning agar assay is one which we believe offered advantages as an indicator of changes in cell proliferation. To this end we have employed 2 human colon cancer cell lines, Colo 205 and Colo 320 DM, and limited studies have been performed with other cell lines. Within the context of our goals and objectives, we believe that these cell lines constitute a suitable system for study of EM exposure induced changes in cellular structure and function.

Specifically commenting on (b) Experimental Design and (c) Quality of Data: Of 27 experiments discussed at this meeting, it was pointed out that a number of them were preliminary experiments of the type used to help determine appropriate conditions for routine experimentation. Accordingly, a discussion of the experiments and the conditions of the experiments revealed a range of variables and parameters to provide the reviewers with information about the sequential progression of our experiments as we learned more about the system and about possible effects on the cells following exposure to EM fields. While the parameters may have appeared to vary in a random manner as these experiments were discussed, chronology of the experiments would indicate a sequence of decreasing variations appropriate to our aim of determining more standardized exposure conditions.

The basic experimental design used throughout the studies consisted of preparation of tumor cells from continuously growing parent cell cultures in sufficient numbers for each experiment so that equal numbers of cells from the same population were dispersed into 4 identical cell exposure chambers. Each of the cell chambers [was] exposed to one of 4 experimental conditions, namely 3 field exposures (E, M, EM) and one non-exposed control. Following exposure, cells from each of the 4 chambers were prepared and assayed for their clonogenic capacity in soft agar assay. In the experiments discussed at the site visit the colony size used as an endpoint was not varied and was constantly greater than or equal to 60 microns in diameter as counted by the Bausch & Lomb FAS II image analyzer.

It should be emphasized that each of our experiments was internally controlled with concurrent non-exposed cultures from the same population as the cells which were exposed to the three conditions of EM fields. Each experiment was evaluated individually on the basis of the internal control.

Statistical analysis of the data using the six individual plate counts for each data point, performed and analyzed at CRTC under the direction of Dr. Phillips, has indicated that for those studies

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reported at several scientific meetings, a significant effect of EM exposure on clonogenic capacity does exist.

Direct comparisons of the individually controlled experiments is undoubtedly complicated by differences in the populations of target cells from one time to the next. No one knows what constitutes a target for E, M or EM fields and the possible influences on cell state, cell orientation in the field and even the cell's relationship to geomagnetic forces are being recognized and are subjects of investigations by others.

The problem of inherent noise sufficient to rule out any conclusion is based on the variability of the number of cell clones produced within the sets of control cultures in each of the individual experiments shown. Data shown had variability in the magnitude of response of cells to EM fields. It was discussed and acknowledged that variability in the magnitude of response of cells is not unreasonable to expect. Until research identifies what allows a cell to respond and until research allows such responses to be maximized, such a variability in response is to be expected. For that reason, concurrent internal controls such as the ones we use are an absolute requirement for *in vitro* EM exposure studies.

In summary, 1) No attempt has been made nor is being made to correlate our *in vitro* studies with an *in vivo* situation, 2) A number of the experiments discussed were preliminary thus supplementing, but differentiated from, those performed under a set of standard experimental conditions, 3) Statistical analysis of CRTC data indicates a significant effect of EM field exposure on clonogenic capacity, an effect not explained on the basis of randomness or bounce in the system and 4) Since no one knows what constitutes a target for EM radiation, response in the system is expected to be variable and, accordingly, each experiment must be controlled and evaluated individually.

Sincerely,

Wendell D. Winters, Ph.D.

Draft Guidelines for Exposure of Personnel to Stray Emissions from Radiofrequency (RF) Dielectric Sealers and Heaters

In the October 11 issue of the Federal Register, *the Food and Drug Administration's Center for Devices and Radiological Health announced the availability of draft guidelines to limit the exposure of radiofrequency (RF) sealer and heater operators to electromagnetic fields (49* FR *39992). These guidelines, which were not included in the* Federal Register *notice, are reprinted below. A public meeting to discuss the guidelines has been scheduled for November 15-16 in Rockville, MD. For more information, contact the center's Howard Bassen (301-443-6536) or Dr. Zory Glaser (301-443-7155).*

The measured values of radiofrequency (RF) electromagnetic fields emanating from some RF dielectric heaters and sealers in the U.S. exceed all world RF exposure standards. Government agencies charged with protection of health and safety have a responsibility to act to reduce excessive RF exposure to people. The Food and Drug Administration (FDA) is concerned about the potential adverse health effects on individuals exposed to radiofrequency energy emitted by RF sealers, heaters and gluers. These devices (hereafter referred to as "RF sealers") are also known as: heat sealers, fusers, molders, fasteners or embossers, high frequency sealers or dryers, electronic or electromagnetic sealers or welders, and dielectric heaters. They are generally designed to operate at frequencies between 3 and 100 megahertz (MHz).

On September 12 and 13, 1979, FDA's Bureau of Radiological Health (BRH), now the Center for Devices and Radiological Health (CDRH), and the Occupational Safety and Health Administration (OSHA) sponsored a public meeting to gather information on, and to address their concern about, the potential adverse health effects on people exposed to RF sealer emissions. Representatives of BRH, OSHA and the National Institute for Occupational Safety and Health (NIOSH) presented data from surveys and measurements performed in workplaces where RF sealers, heaters and gluers were in use. These data showed that RF field strengths (electric and magnetic fields) were very high (more than 1,000 volts/meter (V/m) and 10 amperes/meter (A/m), respectively, both of which are far in excess of 100 milliwatts per square centimeter mW/cm^2 equivalent power density); thus, exposure of individuals often exceeded the existing U.S. voluntary RF personnel exposure standards. At the meeting, RF hazard survey instrumentation was discussed, including commercially available and experimental instruments. Usage considerations and future needs were also discussed. A review of biological effects, including known animal and human effects also took place. In general, all agreed that the level of knowledge about effects was low compared to that of microwave radiation (usually at frequencies of 300 to 10,000 MHz). RF sealer radiation control technologies, including shielding and grounding, and operator location factors were also discussed.

To address these concerns, FDA, which regulates emissions from electronic products, has developed the following guidelines for RF sealers:

> FDA recommends that manufacturers construct and users operate RF sealers and related equipment in such a way that people are not exposed to time-averaged root mean square (rms) electric or magnetic fields in excess of 60 V/m or 0.16 A/m, or maximum values (as a ceiling) of 300 V/m or 0.8 A/m, measured in the vertical frontal plane (anterior surface) of the normal position of the operator. RF sealer manufacturers should also supply instruction manuals and appropriate labeling of RF sealers which provide adequate directions for safe use and warn users of potential hazards which might result from improper equipment modification or use.

FDA makes these recommendations in light of recent scientific reviews of existing standards for exposure to RF energy by such groups as the American National Standards Institute (ANSI), the American Conference of Governmental Industrial Hygienists (ACGIH), the National Institute for Occupational Safety and Health (NIOSH) and Health and Welfare, Canada. In addition, FDA believes that newly manufactured RF sealers can be constructed and old units can be economically retrofitted by methods such as shielding so as to achieve these proposed levels.

FDA will encourage voluntary compliance with these guidelines because it believes the approach of voluntary compliance is an expedient and cost-effective means to significantly reduce exposure of people to stray RF energy emanating from RF sealers. FDA will continue to assess the significance and level of exposure of individuals to stray RF energy from RF sealers and the impact of implementation of these guidelines. FDA will work closely with other agencies and groups concerned with this human exposure situation, and will, if necessary, consider other actions such as a regulatory performance standard for newly manufactured sealers, "defect action" for sealers manufactured after October 1968 which emit RF levels significantly in excess of these suggested guidelines, and/or purchasing specifications for government acquisition of RF sealers.

UPDATES

BIOLOGICAL EFFECTS

VLF Bioeffects...ONR has awarded Dr. Ross Adey of the VA Hospital in Loma Linda, CA, a $248,000, two-year contract to investigate potential bioeffects in the 10-100 kHz frequency range. Adey and co-workers will examine behavioral and neurochemical effects of CW, pulsed and amplitude modulated fields. In addition, they will study possible cellular mechanisms of interaction. Last year, the Air Force funded researchers at the Universities of Washington and Utah to study VLF hazards (10 kHz-3 MHz), with the objective of setting safety standards to protect against shock, fibrillation or burns (see *MWN*, May and September 1983).

More on DNA Resonances... In our May issue, we described recent experiments which show that aqueous solutions of DNA can resonantly absorb microwaves. A paper detailing these findings has now been published in the September 24 issue of *Physical Review Letters*. The research group of Drs. Glenn Edwards and Christopher Davis of the University of Maryland, College Park, NCI's Dr. J.D. Saffer and FDA's Dr. Mays Swicord concludes: "Although there is no demonstrated relationship between these phenomena [microwave resonances] and reported genetic effects, these observations indicate that a mechanism exists for coherent frequency-specific deposition of microwave energy in DNA. This mechanism has surprising physical characteristics and intriguing implications for future polymer and biochemical research. It is unexpected that DNA solutions exhibit microwave resonances and fascinating that such sharp resonances occur in dense solutions at room temperature. It will be interesting to see if these phenomena can be used to alter biochemical processes and if similar phenomena exist in other symmetric macromolecules." The work will continue in Davis's lab under a new $103,000, two-year award from ONR. Edwards, who worked on this project as part of his doctoral thesis, will pursue his research on microwave effects under a one-year, post-doctoral fellowship at the Max Planck Institute in Stuttgart, Germany....The possibility that microwaves could interact with DNA was originally suggested by the theories of Dr. Earl Prohofsky of Purdue University. Science writer Stefi Weisburd outlines Prohofsky's work on DNA vibrations in the June 9 *Science News*.

COMMUNICATIONS

Secure, Airborne and Cordless Telephones... President Reagan has signed an order to improve the security of classified phone calls. National Security Directive 145 could lead to the purchase of as many as 500,000 telephones protected against Soviet eavesdropping, thus guarding conversations between military and intelligence officials and private contractors. More than $33 million has already been allocated for computers to encode and decode telephone transmissions. Each phone is likely to cost between $15,000 and $30,000, though the NSA hopes to develop a less expensive model. Current plans call for the purchase of 30,000 secure units, but NSA officials are lobbying the administration to purchase an additional 470,000 phones, according to *The New York Times*. Concerned that excessive caution may end up costing taxpayers a lot of money, Oklahoma Congressman Glenn English has asked the GAO to evaluate the need for the new phones. "The national security bureaucracy has a tendency to require a degree of protection for classified information that may be excessive," he suggested to the GAO....Six airlines have introduced cordless telephones on some of their flights to allow passengers to "reach out and touch" people from their seats at 30,000 feet. Using a nationwide network of ground receiving stations, the Airfone Inc. system is capable of handling a total of 222 calls simultaneously. The cost of calls is likely to deter chatting, however — the first three minutes cost $7.50 and each additional minute is $1.25. The FCC has allocated the frequencies used by Airfone on a temporary basis only and has yet to decide whether the allocation should be permanent....A federal jury has awarded $150,000 to a St. Louis man who suffered hearing damage caused by the ringer in the earpiece of his cordless telephone. The precedent-setting decision is the first among more than a dozen pending suits. The FDA's Center for Devices and Radiological Health (CDRH) has received more than 120 complaints about the ringing problem. Officials there are studying the problem and considering action, including the possibility of a recall. Explaining the problem, a recent issue of the center's *Radiological Health Bulletin* (August 1984) notes that: "Laboratory tests indicate that some phones emit sound levels that may exceed thresholds for hearing loss as well as established standards for occupational auditory exposure." When cordless phones were introduced, many manufacturers put the bells, which ring at close to 140 decibels, in the phones' earpieces. Hearing experts explain that the intensity of the ring is comparable to a pistol shot beside your ear. Virtually all companies have since moved the ringers elsewhere in the phone. For information on CDRH's research, contact Wendy Johnson, CDRH (HFZ-100), 5600 Fishers Lane, Rockville, MD 20857, (301) 443-5860.

COMPATIBILITY & INTERFERENCE

Preparing for Radio Marti... The FCC has removed the $250,000 compensation cap for costs incurred by broadcasters who must protect against possible interference from Cuba in retaliation for Radio Marti broadcasts. At a meeting on August 1, the commission also ruled that the costs of protective equipment were reimbursable, less depreciation on the equipment being replaced (see *MWN*, April 1984). Notice of these changes appeared in the August 28 *Federal Register* (49, *FR* 34004). FCC action was prompted by a petition for reconsideration filed on April 30 by the Florida Association of Broadcasters and the South Florida Broadcasters Association. In its notice, the commission noted that congressional sponsors of the Radio Broadcasting to Cuba Act, which established Radio Marti, supported the petition, as did the United States Information Agency (USIA), which will operate Radio Marti through its Voice of America (VOA) branch. For information, contact FCC's Louis Stephens at (202) 632-7792....In related developments,

Paul Drew has been hired as a consultant to Radio Marti and is expected to take over as director, pending congressional approval. In addition to Drew, VOA has hired 58 of its projected staff of 150. The station, which USIA officials hope will begin operating soon, will broadcast at 1180 kHz....To help broadcasters determine the level of potential interference, the FCC has prepared a list of Cuban radio stations known to operate on the 107 channels allocated for AM broadcasting in the U.S. It is available for $0.49 from Wilbur Thomas, International Transcription Service, Inc., 4006 University Drive, Fairfax, VA 22030, (703) 857-3800.

GOVERNMENT

FCC RF Sampling Program... The FCC's Equipment Authorization Branch has changed its policy and will no longer test new types of equipment for potential RF interference before permitting them to be marketed. Branch Chief Charles Cobb explained that new products will be granted approval solely on the basis of testing data submitted by manufacturers. In the past, the agency required some applicants to provide prototypes for testing prior to market approval. Now, sampling will be done later on production models. Cobb emphasized that the change was made to "speed up development and introduction of new technology." Under the new procedures, sampling will focus on cordless telephones, computing devices and RF lighting sources. Cobb estimated that the FCC receives approximately 10,000 applications each year and that 20-25 percent are rejected because of possible interference problems, while 40-45 percent of the applicants are asked to provide additional testing data. For more information on the new program, contact Richard Fabina, FCC Laboratory, PO Box 429, Columbia, MD 21045, (301) 725-1585.

MEDICAL APPLICATIONS

Resources... Drs. Santi Tofani and Giovanni Agnesod of the Italian National Health Service in Ivrea report on their studies of stray electric fields from capacitor-plate applicators used with diathermy equipment operating at 27 MHz in the August 1984 issue of *Health Physics*....Dr. Leonard Taylor of the University of Maryland has shown that, in the near field, the electromagnetic waves from suitably designed applicators can penetrate far deeper than the skin surface. His explanation appears in the October *IEEE Transactions on Antennas and Propagation*....Drs. M.K. Hessary and K-M. Chen of Michigan State University in East Lansing present a theoretical method of analyzing capacitor-plate applicators in "EM Local Heating with HF Electric Fields" in the June 1984 *IEEE Transactions on Microwave Theory and Techniques*....A team from Carnegie-Mellon University in Pittsburgh, PA, headed by Dr. Robert Peloso has failed to observe any differences in the measured dielectric properties of normal and neoplastic tissues in the 1 MHz-1 GHz frequency range. See the November *IEEE Transactions on Biomedical Engineering*....Professors Thomas Budinger and Paul Lauterbur, two of the developers of NMR imaging, have written a review paper on "Nuclear Magnetic Resonance Technology for Medical Studies," published in the October 19 *Science*....Academic Press has started a new quarterly journal, *Magnetic Resonance in Medicine*, the official journal of the Society of Magnetic Resonance in Medicine. Subscriptions are $72.00 in the U.S. and Canada and $84.00 elsewhere. Contact: Academic Press, 111 Fifth Ave., New York, NY 10003, (212) 741-6802....The Congressional Office of Technology Assessment has released two new studies, *The Emergence of Nuclear Magnetic Resonance Imaging Technology: A Clinical, Industrial and Policy Analysis*, (GPO No. 052-003-00964-1) and *Federal Policies and the Medical Devices Industry* (GPO No. 052-003-00965-0). Copies are available for $5.50 and $7.00 respectively (prepaid) from the U.S. Government Printing Office (GPO), Washington, DC 20402....Professor Richard Borgens of Purdue University in West Lafayette, IN, has published "Endogenous Ionic Currents Traverse Intact and Damaged Bone" in the August 3 *Science*.

MEETINGS

Off and On... The *Workshop on Low Level Field Effects on Cells*, scheduled to be held at Brookhaven National Lab on Long Island, NY, in December has been cancelled. Eugene Findl, the workshop organizer, was caught in a "reduction in force" at the Department of Applied Science and left Brookhaven at the end of October. In a telephone interview, he said that his future plans are uncertain, but he was optimistic that the workshop would be held in 1985 with a new sponsor....On November 29-30, there will be a meeting in London, England, to explore what is known about the clusters of miscarriages and birth defects among VDT operators. Sponsored by Humane Technology, which was set up by Brian Pearce of the HUSAT Research Center at Loughborough University, *An International Meeting to Examine the Allegation of Reproductive Hazards from VDUs* will feature speakers from the UK, Canada and Sweden. Representatives from IBM-UK and the BBC are on the program, as is Dr. Karel Marha of the Canadian Center for Occupational Health and Safety. See "Conference Calendar" for details.

Proceedings Available... The proceedings of the *19th Annual Symposium of the International Microwave Power Institute* (IMPI), held in Minneapolis, MN, in September, are now available. Topics covered include microwave ovens, plasma wave heating for nuclear fusion, bioeffects, measurements and industrial applications. The 237-page volume, which includes a mix of abstracts and complete papers, is available for $25.00 (prepaid) from IMPI, Tower Suite 520, 301 Maple Ave. West, Vienna, VA 22180, (703) 281-1515....The American Institute of Medical Climatology (AIMC) has released the proceedings of its *Conference on Environmental Ions and Related Biological Effects*, which was held in October 1982 in Philadelphia, PA. The 159-page, typescript report features five papers on the bioeffects and measurement of ions associated with high voltage DC power lines and with indoor air pollution. Each paper is followed by a brief commentary. A copy of the proceedings

is available for $15.00 for AIMC members ($25.00 for others) from AIMC, 1023 Welsh Road, Philadelphia, PA 19115, (215) 673-8368.

MILITARY SYSTEMS

EMPRESS II Hearings... The Navy has scheduled three hearings on its proposal to site an Electromagnetic Pulse Radiation Environment Simulator for Ships (EMPRESS II) on the Chesapeake Bay. Hearings will be held in Virginia on November 14 at the Rappahannock Community College North Campus in Warsaw and on November 15 at the college's South Campus in Glenns. In Maryland, a hearing is scheduled for November 20 at South Dorchester High School in Cambridge. (See *MWN*, September 1984 and related story in this issue on p.4.) For further information, contact Lt. Pietropaoli, Office of Information, Department of the Navy, Washington, DC 20350, (202) 697-5342.

OVENS

Sales Boom... Microwave oven manufacturers shipped more units in the first three quarters of 1984 than in all of 1983. The Association of Home Appliance Manufacturers (AHAM) reports that 6.2 million units were distributed through September 30, an increase of 61.4 percent over the totals for the first three quarters of 1983. In September 1984 alone, the industry shipped 310,000 more microwave ovens than in the same month last year. Industry observers explain that smaller, less expensive models, combined with rising discretionary income among consumers, account for the sharp rise in sales. American oven manufacturers have lost some of their dominance over the market, however. They now produce just 60 percent of the ovens bought in the U.S., down from their 74 percent share of the market in 1981.

PEOPLE

Eric Lerner, a contributing editor of *IEEE Spectrum* well known for his 1980 and 1984 articles on bioeffects, is out of a job. His freelance contract with *Spectrum* has not been renewed because, as he was told by his editors, all writing and editing would now be done by the in-house staff. The decision to let Lerner go followed soon after a letter of complaint was sent to Dr. **Richard Gowen,** president of IEEE, by Drs. **Sol Michaelson** and **John Osepchuk.** Writing on University of Rochester stationery, they complained that the May 1984 *Spectrum* article, "Biological Effects of Electromagnetic Fields," presents "an unbalanced and misleading treatment of the subject," and that, "such a distorted presentation will be used by mischievous elements to stimulate unnecessary and irrational fears of electromagnetic fields in our modern society." Michaelson of the University of Rochester and Osepchuk of Raytheon accused Lerner of emphasizing material that is "speculative, far from being substantiated and of questionable validity." The Lerner article was based on a round table discussion held at the 1983 BEMS meeting. Those who participated included some of the leading researchers in the field: Drs. **Ross Adey, Larry Anderson, Frank Barnes, C.K. Chou, Friedrich Kremer, Shirley Motzkin, Mays Swicord,** and **Howard Wachtel.** Dr. **Ken Foster** was also involved but he later asked that his contributions be deleted from the article. Michaelson and Osepchuk concluded their letter with the following statement: "IEEE officials should ponder what type of actions are required to prevent further repetition and perpetuation of misinformation through *Spectrum* when the damage to IEEE's reputation finally becomes clear as events evolve in this field" *Spectrum* editor **Donald Christiansen** did not return telephone calls requesting comment. Barnes, who served as the chairman of the BEMS meeting panel, said that he had been told by IEEE staffers that Lerner's fate had nothing to do with the articles or the Michaelson-Osepchuk letter. Adey thinks differently. He told *Microwave News* that he doubts the events were unrelated. In addition, Adey said that *Spectrum* had recently refused an introductory paper on mechanisms of interaction between electromagnetic radiation and biological systems, which had been *invited* by the magazine. When Lerner was asked if he believes there was any connection between the cancellation of his contract and the Michaelson-Osepchuk letter, he said that not only had the magazine not renewed his contract but had initially tried to renege on the existing agreement, which had only a short time left to run. "It is impossible to say anything definitive," he said, "because I am the only freelancer at *Spectrum*, but the timing is suspicious."...Dr. **Lionel Jaffe** has dropped out of the AIBS committee preparing a report on the bioeffects of ELF radiation for the Navy (see *MWN*, July/August and September 1984). According to Dr. **H.B. Graves,** the chairman of the AIBS study panel, Jaffe pulled out due to time pressures caused by his leaving Purdue University to join Woods Hole Oceanographic Institution. Dr. **Asher Sheppard,** already a member of the committee, will take over Jaffe's responsibilities for covering bone growth and fracture repair. Sheppard said that he will be relying on Dr. **Richard Luben** for assistance in his new duties....Dr. **Larry Anderson** will be replacing Dr. **Richard Phillips** as the coordinator for bioelectromagnetic studies at Battelle Pacific Northwest Labs. Phillips is moving to EPA's Experimental Biology Division in North Carolina.

POWER LINES

Winters Replication... The New York State Power Lines Project has decided not to attempt an exact replication of Dr. Wendell Winters's study which found that exposure to ELF fields enhanced the growth rate of certain lines of human tumor cells. Instead, the project is likely to fund an investigation of the effects of 60 Hz fields on a different type of human tumor cell. Responding to criticisms from Drs. Jeffrey Trent and Ronald Buick following a site visit to Winters's lab this summer (see *From the Field*, p.6), the project's scientific advisory panel has asked Dr. Gordon Livingston of the University of Utah to collaborate with Trent on revising his original proposal for a $30,000 replication study (see *MWN*, October 1984). A final decision on the Livingston study is expected by the end of the year. At this point the panel has not decided what kind of support it

might offer to Dr. Maimon Cohen for additional work in the same area. The panel initially asked both Livingston and Cohen to submit proposals for replication studies. Both researchers are already project participants.

STANDARDS

San Diego Adopts ANSI Standard... San Diego County, CA, has adopted the 1982 ANSI exposure standard for RF/MW radiation. The September 12 action by the county's Board of Supervisors is part of a broad plan to develop a regional telecommunications policy (see *MWN*, September 1984). According to Bill Chatham of the Department of Planning and Land Use, the rules were adopted to eliminate uncertainty in the communications industry. Operators may request waivers to the rule on a case-by-case basis.

VDTs

Legislation... Massachusetts has allocated $75,000 for a six-month VDT health and safety study. Added to the state budget by Rep. Elizabeth Metayer, a sponsor of VDT legislation, the money will be used by the Department of Labor and Industries' Division of Occupational Hygiene to "evaluate virtually every aspect of VDT work," according to a legislative staffer....Oregon's Senate Interim Labor Committee has released a final report on its eight-month investigation of VDTs. Formed in late 1983 after proposed VDT legislation was tabled until the Senate reconvenes in January 1985, the 16-member committee has made several recommendations. It urges the Labor Committee to set a statewide policy defining safe, healthy working conditions, encourages research in areas of uncertainty — including reproductive hazards — and directs the state's Accident Prevention Division of the Workers' Compensation Department to develop an educational program. Radiation risks are downplayed by the committee. A committee staffer told *Microwave News* that proposed legislation is being prepared for consideration in early December. If it gains committee support, it will be introduced when the legislature reconvenes in January. A copy of the report is available from the committee, 331 State Capitol, Salem, OR 97310, (503) 378-5720....The New York State Assembly Standing Committee on Labor has published a report on hearings it held last year (see *MWN*, May 1983). *Video Display Terminals – Blessing or Curse?* urges legislators "to err on the side of caution" in assessing radiation risks and to legislate VDT use "to minimize this possible danger." For a copy of the report, contact the office of Assemblyman Frank Barbaro, Room 713, Legislative Office Building, Albany, NY 12248, (518) 455-5828....Pennsylvania State Senator Buzz Andrezeski has introduced two bills, SB 1450 and SB 1451. Similar in almost all respects, the proposals would require shielding to block RF emissions, periodic rest breaks, office design guidelines and a maximum of five hours per day of VDT work. In addition, both bills would mandate alternative work upon request for pregnant operators. The key difference between the bills is that SB 1450 applies only to public employees, and SB 1451 applies to both public and private employees....Berkeley, CA, has become the first locality to adopt VDT purchasing rules. Approved by the City Council, the new ordinance restricts the type of VDT-related equipment which the city may purchase but stipulates only that furniture be safe and comfortable and that displays have adjustable contrast controls.

CONFERENCES

November 29-30: **An International Meeting to Examine the Allegations of Reproductive Hazards from VDUs,** London, UK. Contact: Humane Technology, PO Box 2, Quorn, Leicestershire, LE12 8EG, UK, (0509) 237428.

December 4-8: **American Clinical Hyperthermia Meeting,** Americana Canyon Hotel, Palm Springs, CA. Contact: Dr. Haim Bicher, Daniel Freeman Memorial Hospital, 333 N. Prairie Ave., Inglewood, CA 90301, (213) 674-7050.

December 6-7: **24th Automatic RF Techniques Group Conference,** Columbia Inn, Columbia, MD. Contact: ARFTG, PO Box 432, Princeton, NJ 08540.

1985

January 23: **A Review of the State-of-the-Art in EMC in Commercial and Military Electronics,** LA Airport Hilton, Los Angeles, CA. Contact: Ms. Terry Cantine, Eaton Corp., 5340 Alla Rd., Los Angeles, CA 90066, (213) 822-3061.

January 23-25: **RF Technology Expo,** Disneyland Hotel, Anaheim, CA. Contact: Kathy Kriner, RF Tech Expo, 6530 S. Yosemite St., Englewood, CO 80111.

February 3-8: **1985 Winter Meeting of the IEEE Power Engineering Society,** Penta Hotel, New York, NY. Contact: T.A. Balaska, Bishop Electric Corp., 363 Old Hook Rd., Westwood, NJ 07675, (201) 666-5553.

March 5-7: **6th Symposium & Technical Exhibition on Electromagnetic Compatibility,** Zurich, Switzerland. Contact: EMC Symposium & Exhibition, ETH Zentrum-IKT, 8092 Zurich, Switzerland, (01) 256-27-90.

SHORT COURSES

December 17-18: **EMI & EMP Testing to the Requirements of MIL-STD-461/462,** West Conshohocken, PA. Fee: $595. Contact: R&B Enterprises, 20 Clipper Rd., West Conshohocken, PA 19428, (215) 825-1960.

1985

January 21-24: **Millimeter Wave Systems and Technology,** Atlanta, GA. Fee: $550 (3 days), $725 (4 days). Contact: Dept. of Continuing Education, Georgia Institute of Technology, Atlanta, GA 30332, (404) 894-2400.

January 22-24: **Cable Ampacity Calculations for Commercial, Industrial and Utility Applications,** Atlanta, GA. Fee: $575. Contact: Georgia Tech, see January 21 above.

January 28-29: **Grounding, Bonding & Shielding,** Washington, DC. Fee: $650. Contact: Continuing Engineering Education, George Washington University (GWU), Washington, DC 20052, (800) 424-9773, or (202) 676-6106 in DC. **Repeated** May 2-3.

February 5-8: **Modern Microwave Techniques,** Orlando, FL. Fee: $675. Contact: Linda Billard, Technology Service Corp. (TSC), 962 Wayne Ave., Suite 600, Silver Spring, MD 20910, (800) 638-2628, or (301) 565-2970 in Maryland.

February 13-14: **Microwave Devices: Present and Future,** Atlanta, GA. Fee: $475. Contact: Georgia Tech, see January 21 above.

February 19-22: **Modern Microwave Measurements and Applications,** Los Angeles, CA. Fee: $845. Contact: UCLA Extension Short Courses, PO Box 24901, Los Angeles, CA 90024, (213) 825-1295.

February 19-22: **Millimeter Wave Radar,** Washington, DC. Fee: $835. Contact: GWU, see January 28 above.

MICRO WAVE NEWS

Vol. I No. 9 A Monthly Report on Non-Ionizing Radiation October 1981

INSIDE...

AROUND THE WORLD p. 5
IRPA & UK

BIOLOGICAL EFFECTS p. 5

CONFERENCES p. 8
Calendar & Short Courses

GOVERNMENT p. 4

REPORTS p. 3
NCRP & SPS

SATELLITE COMMUNICATIONS
Briefs p. 3

STANDARDS p. 7
ANSI

UPDATE p. 6
EMP, Litigation, Medical Applications, Military Systems, Ovens, Radar and MM Waves, Technology, VDTs

HIGHLIGHTS...

New Radiation Warning Sign p. 7

Another VDT Cataract Claim p. 6

ELF Literature Review p. 5

Radiation Policy Council Closes p. 4

Satcom Siting: The Search for Radiation Safety Assurance

The satellite communications industry is booming, and the demand for earth stations is brisk. Federal Communications Commission (FCC) records show that 911 transmit and 4,862 receive stations have been licensed or have applications pending. According to an informal survey of government agencies and earth station manufacturers, these numbers will grow sharply in the 1980s. This bullish forecast is bolstered by several major suppliers reporting annual sales growth of up to 50 percent.

Proposed stations have sparked community opposition, a common reaction to the siting of major facilities like power plants and highways. The technology of the communications revolution, however, has added a new dimension to these disputes: radiation health hazards. Potential neighbors of transmitting stations are worried and confused about microwaves. Industry and citizens would welcome a federal radiation standard clarifying what levels are safe, but rule making has been slow. The Environmental Protection Agency (EPA) is not expected to propose guidelines until 1983 or 1984.

The FCC is also examining radiation safety. Efforts toward a policy statement were begun in June 1979 with a notice of inquiry (44 *Federal Register* 37008). Expected for several months, the commission's statement may finally be released this November, according to the FCC's Robert Cleveland.

The following three case studies, involving rural, urban and farming com-

(continued p. 2)

Disagreement Over Microwaves at IEEE

Members of two committees of the Institute of Electrical and Electronic Engineers (IEEE) are at odds over microwaves. At issue is a draft position paper on human exposure to radiofrequency and microwave (RF/MW) radiation prepared by the IEEE's Committee on Man and Radiation (COMAR). COMAR wants the statement adopted by the IEEE as a whole, but has run into opposition from members of another IEEE group, the Committee on Social Implications of Technology (CSIT). An editorial in the CSIT newsletter has sharply criticized the COMAR paper and wants it changed. Relations between COMAR and CSIT are now strained.

The COMAR statement seeks to reassure a wary public that there is little to fear from RF/MW radiation. For instance, it states that "clearly the known benefits of EM [electromagnetic] technology outweigh even the most speculative risks to the general population," and that a large body of data indicate that "moderate levels of EM fields (average power densities of 1 to 5 mW/cm^2) are easily tolerated by human beings, at least for short periods, while prolonged whole-body exposure at high intensities (above 100 mW/cm^2) is dangerous at frequencies for which significant energy is coupled to the human body." It goes on to endorse the new ANSI standard.

(continued p. 8)

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munities, reveal how the safety issue can affect satcom station siting.

RCA in Bainbridge Island

RCA Corp.'s plans for a satellite communications station in a rural community on Bainbridge Island, WA, are currently stalled. A local group, the Bucklin Hill Neighborhood Association (BHNA), which opposes construction of the $3-5 million facility, has won its fight for an environmental impact statement (EIS). On August 21, the Kitsap County Office of Community Development, which has jurisdiction in Bucklin Hill, ruled RCA must prepare an EIS under the State Environmental Protection Act. According to the written ruling, "an objective survey of current information of the short and long term impacts on human health" is of particular concern.

Possible radiation health hazards were the main issue in the BHNA push for the EIS. The association's lawyer, Roger Leed of Seattle, argued that very little is known about potential radiation levels from the proposed station and that "this lack of information is further compounded by the general lack of knowledge about human health hazards generated by microwave radiation."

Because of the safety debate, Bainbridge Island may take on larger proportions than an isolated challenge for RCA. According to Howard Johnson, RCA staff vice president for product safety, the decision to spend the time and the money on an EIS rather than to look for another site was influenced by the company's desire to resolve this issue: "If we leave this one, next time we could face the same problem."

Johnson cited Home Box Office's (HBO) bid for a station in Rockaway, NJ, to make his point. (See *MWN*, January 1981.) Faced with continuing delays caused by community opposition, HBO scrapped its proposal. He believes HBO's decision "gave people ammunition" to fight other projects.

Indeed, BHNA member Jerry Hellmuth has drawn a parallel between Rockaway and Bainbridge Island. A school 1,000 feet from the proposed HBO site was a major concern to Rockaway residents. Hellmuth, the director of a Bucklin Hill boarding school directly across from the 7.9-acre RCA site, is also worried about the long-term effects of microwaves on children.

BHNA members do not know what radiation levels are safe, and they question the validity of the voluntary ANSI safety standard. Among queries submitted for a community meeting on radiation issues, the association asked: "How can we, who live next to the RCA proposed microwave facility, be guaranteed any safety to our health when no US standard exists that could protect us?"

Calculated power levels near the proposed station are currently being revised. Worst case figures, developed by RCA, were as high as 32 uW/cm² in one location. The regional EPA office's review of these calculations, however, found that they were unrealistically high and that normal levels would be a factor of ten lower. In an August 12 letter to the Kitsap development office, EPA's Elizabeth Corbyn wrote that, based on ANSI's proposed standard, "we do not believe construction and operation of the proposed communications satellite earth station will create an exposure hazard from microwaves."

The EIS is being prepared by the Seattle office of C H_2M Hill, Inc., an international consulting firm, and should be completed by mid-October. Professor A.W. Guy from the University of Washington, Seattle, and Dr. Don Justesen of the VA Medical Center in Kansas City, MO, are assisting with the radiation bioeffects portion of the statement.

The Bainbridge Island station would be the eighth in RCA's national network providing private channel communications service in large cities. Two 43-foot-diameter satcom antennas would be built on the site.

Cylix in Haverford

The zoning board of Haverford, PA, has rejected a station proposed by Cylix Communications Network, Inc. of Memphis, TN. After an emotionally charged hearing in this heavily populated, working class neighborhood near Philadelphia, the board ruled against Cylix on September 21.

Cylix is appealing the decision to the Court of Common Pleas of Delaware County. Company vice president of operations, Dick Furnival, told *Microwave News* that "there were no grounds for turning us down." Finding another site would be difficult and could cost the company $100,000, Furnival said, because of the heavy microwave congestion in the Philadelphia area.

Judging by the initial community reaction to the Cylix proposal, it is likely that residents of Haverford and the adjacent township of Lower Merion will continue their opposition to the station.

Philadelphia lawyer John Trevaskis, a zoning law expert representing Cylix, is confident the appeal will be successful. In a telephone interview, Trevaskis questioned the need to hold a hearing on the Cylix request in the first place. He said hearings are held for satellite stations because "most zoning code enforcement officers just don't know what to do with these applications." His computer check found no earth station zoning cases on the books.

Haverford is slated to join the company's rapidly expanding national network of small, 0.7-watt data communications stations. Now over halfway toward a year-end goal of 25 stations, the company plans to operate over 100 by mid-1985.

COMSAT in Western PA

This summer the Cleveland Township, PA, zoning board approved the Communication Satellite Corporation's (COMSAT) application to build a $50 million earth station on a 107-acre farmland tract. People Questioning COMSAT, a small but active group, has fought the station and wants to appeal the decision. Lack of funds, however, may prevent it from taking further action.

According to People Questioning COMSAT member David Bensen, the group's challenge would be based on zoning law rather than radiation safety issues. "Although we are not convinced the installation is safe," he explained, "we could not prove it is unsafe to the satisfaction of a court of law." The appeal must be filed by mid-October.

COMSAT has described its project in a detailed two-volume application to the FCC. The installation, with three 105-foot-diameter antennas transmitting in the 6 GHz and 14 GHz bands, will join two existing East Coast stations at Etam, WV, and Andover, ME. The Pennsylvania station is designed to help meet an anticipated quadrupling of the region's communications traffic in the next decade.

COMSAT's radiation hazard analysis consists of two pages

out of over two hundred in the application. Company spokesman Roger Cochetti said that clarifying material, including EPA's evaluation of potential radiation levels near the station, will be sent to the FCC soon. These calculations, he points out, are "less conservative" than COMSAT's.

At the company's request, Norbert Hankin from EPA's Non-Ionizing Radiation Surveillance Branch calculated maximum possible microwave levels based on a minimum elevation angle of 5 degrees above the horizon and a maximum power per antenna of 5 kilowatts. (The actual elevation angle would be 26 degrees.) Maximum radiation levels for locations 1,000 feet from the 14 GHz and 6 GHz antennas would be less than 8.7 uW/cm² and 14.6 uW/cm² respectively and much lower for the area beyond 2,000 feet. (The third antenna could operate at either frequency and would function as a backup.) Upper limits rather than expected values were estimated because the near field—an area for which exact calculations are impossible—extends 7 miles for the 14 GHz antenna and 3 miles for the 6 GHz antenna.

In a letter to COMSAT, Hankin concluded that, on the basis of an analytical model and his own experience, "exposure power densities at distances beyond approximately 2,000 feet will be less than 1 uW/cm²....The anticipated microwave exposures which would be produced by the operation of the proposed facility under 'worst case' conditions of power and antenna orientation...should not have any environmental impact; i.e., should not affect the health of humans or animals, nor affect vegetation."

If no appeal is initiated and FCC approval comes through in the next few months, construction could begin next year and the station could be in operation some time in 1983.

BRIEFS

Satellite Communications has published its September directory issue, listing regulatory agencies, satellite carriers, satellite services and hardware and component suppliers....*Star Signals,* a monthly magazine for the earth station receiver industry, was launched this September by Interstar Satellite Systems, Inc. The magazine is the descendant of *Interstar Signals,* the company's widely distributed newsletter. For information, write *Star Signals,* 21708 Marilla Street, Chatsworth, CA 91331....The National Telecommunications Conference, sponsored by the IEEE's Communications Society Conference Board, will be held in New Orleans, LA, November 29–December 3. Contact: NTC '81, Dale Caston, 365 Canal Street, Box 45, New Orleans, LA 70130....The First International Space Communications Workshop will immediately follow NTC '81 in New Orleans on December 3–4. Topics include NASA's 30/20 GHz technical program and spatial frequency reuse techniques. Contact: Dr. A.S. Acampora, Bell Telephone Laboratories, Inc., Room 4E-336, Holmdel, NJ 07733; (201) 949-5692 or Dr. P.A. Kullstam, 6565 Arlington Blvd., Falls Church, VA 22046; (703) 533-8877 ....Antennas are the feature topic in the September *IEEE Communications Magazine*....Over 260 people attended "Space Communication in the '80s," the Sixth Annual Conference on Satellite Communications held September 23–25 in Washington, DC. The meeting was sponsored by the Public Service Satellite Consortium ....Scientific-Atlanta, Inc. is holding a satellite communications symposium in Atlanta, November 2–4. Over 700 participants from all aspects of the industry are expected to attend. For information, contact Betsy Crawley, (404) 449-2274.... Lockheed is developing a space antenna for extending the range of mobile communications units. According to *Science News,* August 29, the collapsible antenna would be 300 meters in diameter and weigh 200 pounds.

NCRP: Biophysics and Bioeffects

The National Council on Radiation Protection and Measurements (NCRP) has issued its first report on non-ionizing radiation. *Radiofrequency Electromagnetic Fields—Properties, Quantities and Units, Biophysical Interaction, and Measurements* is the product of eight years of work by a seven member committee, chaired by George Wilkening of Bell Labs.

The 119-page report includes a brief review of basic electricity and magnetism, a discussion of the interaction of microwaves with biological systems with special emphasis on specific absorption rates (SARs), a description of different types of monitoring instruments, a glossary and a definition of units.

Among the six technical appendices, there is a short discussion of natural background levels of non-ionizing radiation. An index and list of references are included.

The other members of Scientific Committee 39 that prepared the report were: Frank Barnes, Department of Electrical Engineering, University of Colorado, Boulder; Ronald Bowman, Electromagnetic Fields and Antennas Section, National Bureau of Standards; Arthur Guy, Department of Rehabilitation Medicine, University of Washington, Seattle; Karl Illinger, Department of Chemistry, Tufts University; the late Curtis Johnson, Department of Biophysics and Engineering, University of Utah, Salt Lake City; Saul Rosenthal, Department of Electrical Engineering, Polytechnic Institute of New York; and Charles Susskind, Department of Electrical Engineering and Computer Science, University of California, Berkeley.

The report (NCRP No. 67) is available for $10.00 from NCRP Publications, PO Box 30175, Washington, DC 20014. There is a small reduction in price for bulk orders of more than 100 copies.

Another NCRP scientific committee (No. 53) is preparing a report on the biological effects of radiofrequency and microwave radiation. At work since 1977 under the chairmanship of Arthur Guy, the report is nearing completion. According to Dr. Constantine Maletskos, a consultant in biophysics to NCRP and MIT, it is due out at the end of next year.

The members of the committee held a working meeting October 1–2 in Oregon. In addition to Guy, the other committee members are: Ross Adey, VA Hospital, Loma Linda, CA; Edward Alpen, University of California, Berkeley: Stephen Cleary, Medical College of Virginia; Don Justesen, VA Medical Center, Kansas City; Mary Ellen O'Connor, University of Tulsa; and Richard Phillips, Battelle Pacific Northwest Labs, Richland, WA.

OTA: Solar Power Satellites

The Office of Technology Assessment (OTA) has concluded that "too little is currently known about the technical, economic and environmental aspects of SPS to make a sound decision whether to proceed with its development and deployment." The just-released, 300-page OTA report evaluated three alternative systems for beaming solar energy from an orbiting satellite to Earth: microwave, laser and mirror transmission.

The OTA did not recommend a stop to SPS funding, as did the National Academy of Sciences in its own recent SPS report. (See *MWN,* July/August 1981.)

Among the major conclusions related to microwave radiation were:

- "Too little is known about the biological effects of long-term exposure to low-level microwave radiation to assess the health risks associated with SPS microwave systems."
- "The potential for interference with other users of the electromagnetic spectrum could constitute a severe drawback for the microwave option."

A copy of the report, *Solar Power Satellites,* is available from the US Government Printing Office. GPO stock number: 052-003-00848-3. The price is $7.50. A copy of the report's summary is available at no cost from OTA, US Congress, Washington, DC 20510, (202) 224-0885.

GOVERNMENT

Radiation Policy Council Closes Down

The Radiation Policy Council (RPC) went out of business at the end of September. The council, a victim of the Reagan-Stockman budget cuts, had all its funds deleted for the 1982 fiscal year which began on October 1.

Carl Gerber, the director of the RPC, said that the council would be ending its work prematurely but that he was glad he had been able to complete its first phase, issue identification. "It wasn't all a waste," he said, "but I wish I could have taken the issues on directly."

The RPC was set up by President Carter in February 1980 under Executive Order 12194 on the recommendation of an interagency task force chaired by Peter Libassi, the former general counsel of the Department of Health, Education and Welfare, now the Department of Health and Human Services. The task force itself was established after public disclosures that servicemen had been exposed to ionizing radiation from nuclear weapons testing. Under the original order, the council was given a four year mandate, ending in 1984.

The council never addressed non-ionizing radiation issues, though a number of groups had urged it to do so. (See *MWN,* January 1981.)

Gerber said that the council had won the support of the participating federal agencies, industry and professional societies, but that they had not created enough pressure to restore the lost funds. The original Carter FY82 budget had allocated $980,000 for the RPC. In addition to cutting this to zero, the Reagan administration reduced the FY81 budget from $942,000 to $300,000, limiting Gerber to a staff of two part-time consultants and a secretary.

A report on issue identification and analysis is now under review and should be released by the end of the year. Gerber is also writing a final report, which he hopes will one day provide the basis for a continuation of the council's work.

OSHA's Auchter Says RF Radiation is "Serious Hazard"

Thorne Auchter, the administrator of the Occupational Safety and Health Administration (OSHA), has listed radiofrequency radiation as one of the hazards "which OSHA believes merit consideration at this time." In an affidavit required by the Court of Appeals' decision in a suit brought by farm workers seeking a field sanitation standard,* Auchter stated: "The radiofrequency radiation standard addresses a serious hazard to an extremely large number of employees, and Congress indicated that it should be examined."

Auchter described first and second order priorities for OSHA's health standards staff. RF is in the lower category. These priority standards are to be the focus of the agency's work over the next two years. Auchter outlined the RF problem in his timetable:

> NIOSH has estimated that 20 million workers could be exposed to significant levels of radiofrequency radiation. Radiofrequency radiation has a heating effect on the body, and may raise body temperature and cause tissue damage. It may also affect the nervous system. OSHA is gathering information and considering amendment of its current standard (29 CFR §1910.97 Nonionizing radiation). On May 13, 1981 the Subcommittee on Investigations and Oversight of the House Committee on Science and Technology held a hearing on this hazard, and requested that OSHA move more rapidly in its efforts to minimize worker exposure to harmful levels of radiofrequency radiation. The project currently requires the work of two staff members on a part time basis.

**National Congress of Hispanic American Citizens (El Congreso), et al.* v *Ray Marshall, Secretary of Labor, et al.,* 626 F. 2d 882 (DC Cir 1979).

RF Sealer Meeting

The Bureau of Radiological Health (BRH) is hosting an all-day meeting on RF sealers, October 7 in Rockville, MD. Representatives from the Occupational Safety and Health Administration (OSHA), the National Institute for Occupational Safety and Health (NIOSH) and BRH will explore strategies to deal with the RF sealer radiation problem.

Though the agenda is open to all possible control techniques, BRH does not favor performance standards for heaters and sealers. At last May's congressional hearing, chaired by Congressman Albert Gore, Jr., BRH Director John Villforth said that he did not think such emission standards would be effective because the agency did not have the authority to regulate old machines and because many users substantially modify the machines on delivery, thus undoing any built-in shielding. (See *MWN,* June 1981.)

EPA Plan Would Delay Release of Data

A new plan to control the release of research results from the Environmental Protection Agency (EPA) threatens to delay their publication, according to an article in *Science* magazine. Writing in the September 18 issue, R. Jeffrey Smith reports that, under the proposed policy, "scientific manuals and reports would have to follow a circuitous path through the agency involving as many as 30 steps before their conclusions become known to the general public." And "at five different steps, the material can be returned to the author for revision, whereupon the review process begins anew."

In a telephone interview from Research Triangle Park, NC, Daniel Cahill, director of the Experimental Biology Division in EPA's Office of Research and Development, confirmed that, if the proposal goes through, reports from his lab, which is responsible for EPA's research on radiofrequency and microwave bioeffects, could be held up. This would apply even to papers submitted for publication to peer reviewed journals.

With respect to the forthcoming criteria document on non-ionizing radiation, Cahill did not think the new review procedures would cause any extra delays. "This kind of document would normally go through extensive review in Washington," he said.

The criteria document should be ready for review by EPA's Office of Radiation Programs and Scientific Advisory Board (SAB) by mid-October. Cahill would also like to have a round of external reviews after the SAB has completed its work.

BRIEFS

It does not look as if NIOSH will be moving down to Atlanta. As we go to press the House Appropriations Committee has voted to block the use of CDC-NIOSH money to pay for the move. On the Senate side, the appropriations subcommittee has also voted against the plan. Darlene Christian, vice president of the American Federation of Government Employees Local 41, which represents NIOSH, said that "although no formal statement has been made by NIOSH or CDC, I'm 99 percent sure the move is a dead issue."...OSHA is re-evaluating its enforcement policy for RF/MW radiation. The Office of Field Coordination is in the process of weighing various options for Administrator Auchter....The medical surveillance report prepared by the Rocky Mountain Center for Occupational and Environmental Health at the University of Utah, under contract to OSHA, is now being revised by the center. (See *MWN,* February 1981.) A new draft is expected soon....The FCC staff has prepared a report on radiofrequency interference. A summary of the report was printed in the *Federal Register,* August 13, p. 40900.

BIOLOGICAL EFFECTS

ELF Literature Review

Jack Bridges and Dr. Maurline Preache of the IIT Research Institute in Chicago have published a detailed summary of the biological effects of 50–60 Hz electromagnetic fields. "Biological Influences of Power Frequency Electric Fields—A Tutorial Review from a Physical and Experimental Viewpoint," appears in the September issue of the *Proceedings of the IEEE*. The 19-page review covers the literature through 1979, with 145 references selected from some 3,000 publications.

In their abstract, the authors state:

> ....While considerable data exist on this subject major problems were found in much of the literature. It was found that electric field induces about the same body current into humans as that experienced by individuals touching household appliances. As a consequence, the electric field environment from EHV [extra high voltage] lines is only a subset of the ubiquitous 50–60 Hz electromagnetic environment found throughout industrialized communities. The omission of such environmental considerations has limited the usefulness of a number of studies.
>
> A lack of understanding of how electric fields couple energy into animals has resulted in inconclusive research or inappropriate interpretation of results. A common misinterpretation has been to extend experimental results observed for fish or quadrupeds to erect humans on a simplistic volts-per-meter exposure basis.
>
> While some of the studies reviewed noted potential deleterious effects at likely field levels for animal subjects, none of these reported effects could be unequivocally attributed to direct efforts of the electric fields....

BRIEFS

Martha Piana, David Hellums and William Wilson of Rice University have found that the response of human blood platelets to 2-hour exposure to 40 mW/cm² of 2.45 GHz microwaves is consistent with that predicted by a thermal model. They conclude that the work "yielded no evidence of adverse effects of microwaves on human blood platelets other than those associated with temperature increase in the specimens." *IEEE Transactions on Biomedical Engineering*, September 1981, p. 661....The Smithsonian Science Information Exchange is offering a digest of on-going research projects in government, private and foreign labs on "Hazards of Microwaves." The package (No. AR04) consists of 291 different summaries covering the years 1979–1981. The cost is $55. For more information, contact: SSIE, Room 300, 1730 M Street, NW, Washington, DC 20036, (202) 634-3933....In contract news, the Office of Naval Research has awarded a $217,500 grant to the University of Colorado, Boulder, for research on electromagnetic neural effects. And the R&D Directorate at Wright-Patterson AFB has awarded a $135,281 contract to the Georgia Institute of Technology in Atlanta to study RF radiation effects on excitable tissues.

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AROUND THE WORLD

IRPA

The International Radiation Protection Association's (IRPA) International Non-Ionizing Radiation (NIR) Committee has prepared an assessment of the biological effects of radiofrequency and microwave radiation as a first step toward developing an exposure standard. Environmental Health Criteria Document No. 16 also covers sources of radiation in use as well as levels of exposure. It is at the printer and should be available soon. The IRPA standard, which will cover the frequency range between 100 kHz and 300 GHz, is still under discussion. Another criteria document on extremely low frequency (ELF) radiation should be ready by 1982–83. In addition, the International Labour Office has asked IRPA to prepare an overview of occupational hazards from NIR.

In Washington, DC, for the Bioelectromagnetics and URSI meetings, Annette Duchene, the secretary of the IRPA NIR committee, said that the primary objectives of the committee are:

- to collect all available background data relevant to health protection against NIR
- to establish the basic principles of non-ionizing radiation protection and to develop appropriate internationally acceptable recommendations in this field
- to explore with other international organizations ways for furthering protection against the different types of NIR.

The other members of the committee are: H. Jammet (chairman, France), B.F.M. Bosnjakovic (Netherlands), P. Czerski (Poland), M. Faber (Denmark), D. Harder (F.R. Germany), J. Marshall (United Kingdom), M.H. Repacholi (Canada), D.H. Sliney (USA), J.C. Villforth (USA). The committee also has three consultants: G. Kossoff (Australia), G. Nimtz (F.R. Germany), and G. Wilkening (USA).

Jammet and Duchene can be reached at the Commissariat à l'Energie Atomique, Institut de Protection et de Surete Nucleaire, Departement de Protection, 92260 Fontenay-aux-Roses, France.

UK Postal Workers Want More Research

The Post Office Engineering Union has accused the British government of not doing enough research on the health effects of microwave radiation, according to the London *Times*. A September 9 news item reported that the union had leveled the charge at the Trade Union Congress meeting in Blackpool.

The piece went on to note that the National Radiological Protection Board (NRPB) had the only on-going research program in the country. Professor Edward Grant of Queen Elizabeth College at the University of London had applied to do some bioeffects research but failed to win a grant. A spokesman for the NRPB told the *Times* that a set of safety standards would be proposed next year. (Speaking at last August's URSI meeting in Washington, DC, NRPB's Frank Harlan said that the United Kingdom was presently using a 10 mW/cm² radiofrequency and microwave radiation safety standard.)

Meanwhile the *New Scientist* (September 17) reports that the NRPB has a new director. John Dunster had been named to replace Andrew MacClean, who died two months ago. Dunster was the NRPB's assistant director for operations until 1976, when he joined the Health and Safety Executive.

UPDATE

VDTs....Bill Shea, a typesetter with Local 226 of the International Typographical Union in Vancouver, British Columbia, has filed a workman's compensation suit alleging radiation induced cataracts as a result of working with VDTs....The Ontario Public Service Employees Union (OPSEU) has signed a contract with Dayton T. Brown of Bohemia, NY, to test the VDTs used by Darleen Weiss, a VDT operator seeking workers' compensation for alleged radiation induced cataracts. (See *MWN*, March and May 1981.) Under the $65,000 contract, Dayton Brown will check the units for radiofrequency, microwave, ultraviolet and X-ray radiation, as well as static fields. Similar tests will be performed in gas discharge displays, possible alternatives to CRTs....OPSEU, the Southern Ontario Newspaper Guild and the Ontario Institute for Special Education are sponsoring a three-day conference on VDTs, October 16–18 in Toronto. Paul Brodeur and Jeanne Stellman are among the scheduled speakers....The American Optometric Association has issued recommendations for VDT operator eye care. Eye examinations for new workers and rest breaks are among the association's suggestions, based in part on NIOSH's Bay Area VDT study. For a copy, contact the association at 243 North Lindbergh Blvd., St. Louis, MO 63141 ....Additional coverage of the National Academy of Sciences (NAS) symposium on VDTs and vision held this August in Washington, DC, appeared in the August 27 issue of *New Scientist* and the August 29 issue of *Science News*. (See *MWN*, September 1981.) In the September 5 issue, *Science News* continued its VDT coverage with a detailed report on a Norwegian study linking facial rashes among VDT operators with static electric fields. A report on this work was presented at the NAS symposium....Scientific measurements of fatigue among various types of VDT workers are being performed at the Institute of Ophthalmology at Moorfields Hospital, London. According to a September 23 report in the London *Times*, researchers are monitoring physiological signals in an attempt to establish objective measures for worker fatigue.

Medical Applications....The IEEE MTT-S and COMAR are sponsoring a one-day workshop on medical applications of electromagnetic energy on June 18, 1982, following the International Microwave Symposium (see Conference Calendar p. 8). Invited and contributed papers as well as panel discussions are scheduled. Topics to be covered include hyperthermia, NMR imaging, and radiometry. For more information contact one of the workshop's co-chairmen: Dr. J. Gordon Short, BSD Medical Corp., 420 Chipeta Way, Salt Lake City, UT 84108, (801) 582-5550; or Dr. Gideon Kantor, BRH, 12721 Twinbrook Parkway, Rockville, MD 20857, (301) 443-3840....The proceedings of the symposium on *Biomedical Thermology*, held in Strasbourg, France, last June 30–July 4 (see *MWN*, July/August 1981) are being edited by Dr. Michel Gautherie and Professor Ernest Albert and will be published early next year by Alan Liss, Inc., 150 Fifth Avenue, New York, NY 10011. If you order by November 15, you will receive a 20% discount on the yet-to-be-set publication price....The June 1981 issue of the *Journal of Microwave Power* is devoted to the use of RF and MW hyperthermia for cancer therapy.... According to an article in the September 7 *New York Times*, Intermagnetics General Corp. is the first US company to win a contract to deliver magnets for an NMR imaging system. Columbia Presbyterian Medical Center in New York City has ordered two from the Guilderland, NY, company. According to one market analyst quoted in the article, the NMR market may one day equal and perhaps surpass that of CAT scanners, which now runs about $450 million a year.

Technology....The FCC anticipates a "great demand" for Digital Termination Systems (DTS) radio systems and is now proposing to authorize the 17.7-19.7 GHz band for DTS, in addition to the already allocated 10.55–10.68 GHz band. The commission is also acting favorably on a petition by Farinon Electric to "rechannelize the 18 GHz band to permit narrower bandwidth channel assignments than are currently provided for." (46 *Federal Register* 45635, September 14)....Robert Lagace of Arthur D. Little, Cambridge, MA, presented a paper at last August's URSI conference on a theoretical model to predict "the most favorable operating frequencies and maximum communication ranges for portable radios with loop antennas" in coal mines. The range turns out to peak between 300 and 700 kHz, and is "highly dependent" on the electrical conductivity of the coal seam and its surrounding rock....The Bureau of Mines in Pittsburgh is negotiating a contract with R.A. Isberg, a communications engineer in Berkeley, CA, to design, construct, test and build a mine-wide monitoring system....Rome Air Development Center at Grifiss AFB, NY, is looking for a company to develop a portable, direct current, miniature, multiplexed microwave link for simultaneous transmission and receipt of six color video signals (*Commerce Business Daily*, September 17)....The US Army Mobility Equipment Research and Development Command at Fort Belvoir, VA, is negotiating a contract with Aerodyne Research of Bedford, MA, for additional work on an "advanced microwave pumped laser."

Military Systems....The Air Force will prepare an environmental impact analysis on its proposal to build a third PAVE PAWS radar at Robins AFB, GA. The EIS will also evaluate Moody AFB, GA, as an alternative site. No contractor has yet been selected to do the work....The AF's Electronic Systems Division is looking for a contractor to develop and produce a very low frequency (VLF) miniature receiver, operating between 14 and 60 kHz, for its FB-111 and B-52 bombers (*Commerce Business Daily*, September 1)....Janet Raloff reports on the use of lasers for military communications, especially the blue-green system, which might replace Project ELF, in an article on laser research in the September 19 issue of *Science News*....The Naval Electronic Systems Command in Washington, DC, has awarded the IIT Research Institute in Chicago a $465,535 contract for "technical support for ELF environmental compatibility assurance program."

Litigation....Jill Jonnes's article "Microwave Suits Heat Up" appeared in the September 14 issue of the *National Law Journal*.

Radar and MM Waves....A team from the Department of Atmospheric Sciences at the University of Washington, Seattle,

have concluded that 8.6 mm radar "can provide a unique and powerful tool in evaluating the effects of cloud seeding." (*Science,* September 11)....The IEEE's Microwave Theory and Techniques Society is planning a special transactions issue on *Millimeter Waves* to be published in February 1983. For more information contact: V.G. Gelnovatch or Harold Jacobs, US Army Electronics Technology & Devices Lab, ATTN: DELET-M, Fort Monmouth, NJ 07703....The US Army Communications-Electronics Command at Fort Monmouth is looking for a contractor to review near mm wave communications technology (*Commerce Business Daily,* September 18)....A collaboration between anthropologists and a radar scientist has thrown new light on ancient Mayan land use. In an article in the September 25 *Science,* the group describes their use of 1225 MHz synthetic aperture radar ....The Army's Harry Diamond Labs in Adelphi, MD, is negotiating with the Environmental Research Institute of Michigan in Ann Arbor to develop and demonstrate synthetic aperture radar technology.

EMP....The General Accounting Office (GAO) has issued a report, *Countervailing Strategy Demands Revision of Strategic Force Acquisition Plans* (MASAD-81-35, August 5, 1981), which concludes in part: "If the United States is to maintain deterrence until new weapons are deployed in significant numbers, the current [command, control and communications] network must be rapidly improved." The GAO is worried about the C^3 network's vulnerability to EMP ....William Broad outlined the DOD's plans to deal with the EMP threat in "Military Grapples with the Chaos Factor," in the September 11 *Science.* One strategy is to place greater emphasis on satellite communication systems. Broad concluded, "The EMP threat looms larger as the electronic revolution moves forward."...In response to some of Broad's earlier articles on EMP, UCLA's W.D. Hershberger presented some history of the early strategic work on EMP during the 1960s. His letter appeared in the August 21 *Science*....The Defense Nuclear Agency will host a closed meeting of its Scientific Advisory Group on the effects of nuclear weapons, October 20–22. On the agenda is the survivability of missiles and strategic weapons (46 *Federal Register* 45408, September 11)....The Naval Air Systems Command in Washington, DC, is seeking a contractor for EMP management and technical advisory support (*Commerce Business Daily,* September 21).

Ovens....Magic Chef has laid off 250 workers at its microwave factory in Anniston, AL. In a telephone interview from his office in Cleveland, TN, company spokesman Clyde Whitfield said that the reduction was only temporary—an attempt to reduce inventory. "The current rate of orders has not been up to expectations," he continued. He blamed the downturn on the economy and interest rates. The microwave oven industry as a whole remains strong however. According to the American Home Appliance Manufacturers' monthly report, factory shipments through this August are up 33% over last year: 2,670,000 over 2,003,000 for the first eight months of the year.

ANSI

Health Standard

A couple of negative ballots have been filed on the latest draft of the American National Standards Institute (ANSI) C95.1 safety standard for radiofrequency and microwave (RF/MW) radiation. Consumers Union voted against the proposed revision again, as did Leo Birenbaum of the Polytechnic Institute of New York. Since only negative votes were invited, there is no count of those affirming the new standard.

The Electronic Industries Association (EIA), which has consistently opposed the standard in the past, abstained because it did not have a chance to meet to discuss the changes. Although the trade association passed up this opportunity to vote, individual companies will submit comments in the next round of public review, when ANSI itself requests comments. Howard Johnson of RCA said that his company would probably oppose the standard at that stage, not because of objections to the proposed numerical limits but because of the process by which they were selected. Johnson wants the government rather than a voluntary organization to set a standard.

The Environmental Protection Agency (EPA) did not submit a negative vote, although it too does not approve of the standard. EPA's Dave Janes did not think his silence would be interpreted as approval: "My position has already been made clear, and it has not changed," he said.

The Bureau of Radiological Health (BRH) has dropped its objections and is now willing to support the standard. "While it does not answer all our concerns, we consider it an improvement over the old standard," said BRH's Henry Rechen. Rechen intends to file an official letter, citing the BRH position in the near future.

New Warning Symbol

The new ANSI symbol to warn the public and workers of potentially hazardous RF/MW fields has been approved. The symbol can be placed in a variety of signs but when used separately it must be enclosed in a triangle, as shown in the figure below. The triangle should be yellow. The new abstract symbol replaces the old sign, which was adopted in 1966 and reaffirmed in 1974. The C95.2 standard is now at the printer, and will soon be available from ANSI, 1430 Broadway, New York, NY 10018.



CONFERENCES

CALL FOR PAPERS

• 10th Annual *Northeast Bioengineering Conference,* March 15–16, 1982. Dartmouth College, Hanover, NH. Contact: Professor Eric Hansen, Thayer School of Engineering, Dartmouth College, Hanover, NH 03755, (603) 646-2205.

• *International Microwave Symposium,* June 15–17, 1982. (See calendar.) One or two sessions are planned on bioeffects and medical applications. Contact: Professor Om Gandhi, Department of Electrical Engineering, University of Utah, Salt Lake City, UT 84112, (801) 581-7743. Papers are also being sought for the workshop on medical applications to be held June 18. See Update on p. 6.

• *IMPI Symposium,* July 25–30, 1982. (See calendar.) Papers on non-communication aspects of microwaves. Contact: Gandhi, address given above.

CALENDAR

• October 26–27: *Microwaves and Thermoregulation: A Symposium,* hosted by the John B. Pierce Foundation, New Haven, CT. Contact: Office of Graduate and Continuing Education, Yale School of Medicine, 333 Cedar Street, New Haven, CT 06510.

• November 9–11: 1st Annual Meeting of the *Bioelectrical Repair and Growth Society,* Philadelphia, PA. Contact: Executive Secretary of the Society, 425 Medical Education Building, 36th and Hamilton Walk, Philadelphia, PA 19104.

• December 7–12: 6th International *Conference on Infrared and Millimeter Waves,* Carillon Hotel, Miami Beach, FL. Contact: K.J. Button, MIT National Magnet Laboratory, Cambridge, MA 02139.

1982

• January 13–15: *National Radio Science Meeting,* University of Colorado, Boulder, CO. Contact: S.W. Maley, Dept. of Electrical Engineering, University of Colorado, Boulder, CO 80309.

• March 15–18: *International Workshop on Physics and Engineering in Medical Imaging,* Asilomar Conference Grounds, Pacific Grove, CA. Contact: University Extension, University of California, PO Box AZ, Irvine, CA 92716.

• March 29–April 2: 3rd *International Congress of Thermology,* Bath, England. Contact: Congress Secretariat, Martlet Conference Services, 24 Preston Street, Brighton, Sussex BN1 2HN, England.

• May 24–28: *International IEEE/APS Symposium, National Radio Science Meeting and Nuclear Electromagnetic Pulse Meeting,* University of New Mexico, Albuquerque, NM. Contact: Dr. Kendall F. Casey, Dikewood Corp., 1613 University Blvd., NE, Albuquerque, NM 87102.

• June 15–17: IEEE MTT-S *International Microwave Symposium,* Hyatt Regency Hotel, Dallas, TX. Contact: J.R. Griffin, Texas Instruments, Mail Stop 3432, PO Box 405, Lewisville, TX 75067.

• June 29–July 2: 4th Annual *Bioelectromagnetics Society Meeting,* Beverly Wilshire Hotel, Los Angeles, CA. Contact: BEMS, PO Box 3651, Arlington, VA 22203.

• July 25–30: 17th Annual Symposium of the *International Microwave Power Institute,* Town and Country Hotel, San Diego, CA. Contact: IMPI, 211 East 43rd Street, New York, NY 10017.

• September 6–10: 7th *Colloquium on Microwave Communication,* Budapest, Hungary. Contact: Secretariat of the 7th Microcoll, H-1525, Budapest 114, POB 15, Hungary.

SHORT COURSES

• November 16–20: *Principles of Modern Radar,* Georgia Institute of Technology, Atlanta, GA. Fee: $475. Contact: Department of Continuing Education, GIT, Atlanta, GA 30332, (404) 894-2400.

• December 7–9: *Millimeter-Wave Radar,* George Washington University, Washington, DC. Fee: $575. Contact: Continuing Engineering Education, GWU, Washington, DC 20052, (202) 676-6106 or (800) 424-9773.

Disagreement at IEEE

(continued from p. 1)

Writing in the September issue of the CSIT newsletter, *Technology and Society,* Dr. Norman Balabanian, its editor, found the COMAR document marred by inconsistencies, logical fallacies and inaccurate implications. He specifically objected to COMAR and ANSI's failure to recognize the risks of non-thermal, long-term and partial-body effects. Balabanian feared that the IEEE, and engineers in general, will be viewed as just another special interest group unless its public statements are "factual, objective and unbiased."

In an interview, Balabanian said it was not his intention to comment on the technical content of the COMAR position paper: "I only used it as an example of what IEEE position papers should be like, and the COMAR statement falls short of the desired characteristics."

Some of the language in the COMAR statement, as published side-by-side with the Balabanian editorial, has already been toned down due to pressure from the IEEE. COMAR President Om Gandhi admitted that certain phrases were "unnecessarily abrasive," and these have been edited out. Otherwise, he maintained that "COMAR was sticking by its position paper."

"We are the technical expert committee of the IEEE," Gandhi said, "and we don't see how there can be two expert committees in the field." He referred to "the large number of knowledgeable people on the committee: Professor Carl Durney, the president of the Bioelectromagnetics Society (BEMS), Dr. Donald McRee, of the National Institute of Environmental Health Sciences and the president-elect of BEMS, and Dr. Elliot Postow of the National Naval Medical Center, the editor of the BEMS journal." And "we have obviously looked at low-level phenomena," Gandhi added.

Robert Bogumil, the chairman of CSIT, said that while he is encouraged by some of the changes made by COMAR, "they do not go as far as I would like." He stressed that the purpose of Balabanian's editorial was not to offer an official CSIT position but to stimulate a response from the newsletter readership in order to develop such a position and to make suggestions to COMAR.

Dr. Irving Engelson, director of Technical Activities for the IEEE, said that the solicitation of views from a wide variety of people is a common procedure: "This is the process we go through with all our position papers."

The COMAR statement will be on the agenda of the IEEE's US Activities Board at its October 20–21 meeting in Rapid City, SD, and will be presented for approval at the IEEE's Technical Activities Board's (TAB) December 3–4 meeting in Savannah, GA, according to Gandhi. By then, reactions from CSIT and other IEEE members should be apparent. Engelson would not predict how the 60 TAB members would vote. If approved by TAB, the position paper must still win the endorsement of the full IEEE board of directors.

COMAR is also working on a position paper on "Health Aspects of Video Display Terminals." The first draft, written by John Osepchuk of Raytheon Corp. and Maria Stuchly of Health and Welfare, Canada, is now being reviewed by the COMAR membership. COMAR's plans to make a movie about microwaves are also continuing.

MICRO WAVE NEWS

Vol. II No. 8 A Monthly Report on Non-Ionizing Radiation October 1982

INSIDE...

HIGHLIGHTS pp. 3–4

Reagan Signs Communications Bill: FCC May Issue RFI Standards

EPA and OSHA Delay Health Standards

Minnesota Advisory Panel Reviews DC Power Line Safety

Do-It-Yourself Oven Checks: Library Lends Holaday Meter

Industry Legal and Policy Seminar

CONFERENCE CALENDAR p. 8

UPDATES pp. 4–8

Biological Effects
Communications
Compatibility & Interference
Government
International
Measurement
Medical Applications
Military Systems
Mobile Communications
Occupational Health
Ovens
Power Lines
Radar
Satellite Communications
Standards
VDTs

Microwave News *invites letters from its readers. We ask writers to be brief, and we reserve the right to edit contributions for length.*

Electromagnetic Compatibility Symposium

Making Systems Work Together

There was no sign of a recession at this year's *International Symposium on Electromagnetic Compatibility (EMC).* The convergence of experts from computer companies, defense contractors and the military together with the usual complement of interference and compatibility engineers swelled attendance to a new record: more than 700 people came to the conference in Santa Clara, CA, in the heart of Silicon Valley.

The tone of the September 8–10 meeting was set by Dr. Walter LaBerge of Lockheed Missiles & Space Co. when he warned of impending EMC problems in increasingly complex military hardware. "The world is going to get coupled together and whether it works is still to be determined," he said. LaBerge, the keynote speaker, catalogued the large number of "smart" weapons coming on line—especially those with very high speed integrated circuits (VHSIC)—and pleaded for renewed emphasis on their operations in the real world. Precautions must be taken, he said, to make sure that diverse electronic equipment can operate together without harmful electromagnetic interference (EMI) in all environments, at home and abroad, in a conventional conflict as well as in a tactical nuclear war. Planners must look beyond the rules dictated by the Federal Communications Commission (FCC), he advised.

The Aegis Cruiser

A clear example of the complexities of the task at hand is the new Aegis Combat System aboard the Ticonderoga, the navy's latest guided-missile cruiser: it boasts 25 individual radars, sonars and communication and weapon systems. A dozen of these either radiate or receive electromagnetic radiation making compatibility a necessity. Milton Kant, an EMC engineer with RCA's Government Systems Division in Moorestown, NJ, admitted that there are EMC problems on the Ticonderoga even though it is hardened by an order of magnitude greater than any other navy ship sailing today.

The heart of the Aegis control system is the AN/SPY-1A, a high-powered, phased array radar capable of tracking hundreds of targets simultaneously. Richard Durham, also from RCA, said that during the Ticonderoga's recent sea trials there were no RFI incidents related to the AN/SPY-1A radar, and that the cruiser can operate in a fleet environment where other ships are using the same radar. The ship's X- and L-band radars, however, are not yet free of interference, according to Kant.

In an interview, Kant said that the various systems used on the Ticonderoga were essentially off-the-shelf equipment. He recommended a new research and development program to improve inter-system compatibility. Similar pleas were voiced by other experts at the meeting.

Kant discounted a recent Congressional report that the Aegis cruiser is top heavy and unstable. The claims should be taken with "a grain of salt," he

(continued p. 2)

EMC Symposium *(continued from p. 1)*

said. (The House Appropriations Committee report has not been made public.) The navy maintains that the Ticonderoga met all its objectives during the trials, including speed. "Although the ship has grown in weight, it is not overweight and it is not unstable," a navy spokesman said.

CREAM Program

Dr. Robert Haislmaier, an EMC advisor to the Chief of Naval Operations, presented a progress report on the navy's Combat Readiness Electromagnetic Analysis and Measurement (CREAM) Program. He termed it an "aggressive get well" effort for EMI control. Begun in 1979, the program is developing three new test sets: for antennas and transmission lines (AN/PSM-40), for arc detection (AN/PSM-41) and for intermodulation interference (IMI) (AN/PSM-42).

The antenna test set, devised by the Systron Donner Corp., Van Nuys, CA, has performed well in trials and a follow-up contract has been awarded. The arc detector, developed by the James Biddle Co. in Blue Bell, PA, has proved itself useful in locating RF arcing, caused by induced voltages in shipboard structures capable of generating broadband noise interference to receiving equipment. Similar success is anticipated for the IMI test set developed by the Atlantic Research Corp. of Alexandria, VA. (IMI occurs when two or more high-power transmitters induce RF currents through non-linear junctions in a ship's hull and superstructure. Resulting re-radiation can degrade the performance of sensitive receiving devices.) Engineering development contracts for the latter two sets are scheduled to be awarded in fiscal year 1983.

The CREAM program is also sponsoring a new RF/microwave measurement set, the AN/PSM-46. According to Haislmaier, current ways of measuring radiation on ships are "complicated and inadequate." The objective, he said, is "to make sure our people are protected." Design specifications for the navy's test set are keyed to the new American National Standards Institute (ANSI) safety standard (C95.1). The meter will not measure absolute power densities but will yield a relative reading of the weighted signal levels compared to the maximum intermittent exposure. In response to a request for proposals, the navy has just received two bids from meter manufacturers. These are in the process of being evaluated and a contract could be awarded by the end of the calendar year.

Computing Devices

The FCC's computing devices rules (Part 15, Subpart J) on EMC have prompted increased attention to interference issues from a large number of computer and video game manufacturers. Lawrence Movshin, an attorney with McKenna, Wilkinson & Kittner in Washington, DC, presented a tutorial on his interpretation of the commission's regulations to a packed audience. While all Class A equipment (intended for commercial use) first marketed after October 1, 1981 and all equipment manufactured after October 1, 1983 must be verified for compliance with the rules, there are uncertainties as to how the commission will deal with existing but modified devices. Movshin offered three rules of thumb: (1) when changes are made, test; (2) bring the device into compliance whenever possible; and (3) maintain records so that, if audited, a company can show a good faith effort to comply.

Movshin closed his remarks with some advice: "The FCC has the authority to force compliance, so don't ignore the rules because the FCC will find you and get you." To back up his warning, he said that the commission takes complaints from competitors "very seriously." In addition, he said that the commission was stepping up its audits and cited as an example a recent check of all equipment in a retail store in Baltimore.

Computer Interference

One intriguing example of the growing susceptibility of modern computers to EMI was revealed by Robert Goldblum of R&B Enterprises in Plymouth Meeting, PA. He said that he had a client at the World Trade Center in downtown New York City whose computers were going "haywire." Goldblum told *Microwave News* that many computers were not designed to operate in environments with spurious electric fields: fields of 1-10 V/m and sometimes as high as 20 V/m are not uncommon in congested urban areas. Retrofitting can be very expensive, costing tens of thousands of dollars, and in some cases manufacturers are not covering EMI effects under their warranties. Goldblum said that he is receiving two or three calls a month from New York City alone, alleging EMI, mostly from companies with computers in high-rise buildings in line-of-sight with the Empire State Building or the World Trade Center antennas.

(In its July 19 issue, *Computerworld* described "intermittent hardware failures" among users of Hewlett-Packard HP 3000 computer systems. The article cites a Hewlett-Packard spokesman as saying that radio transmissions from the Empire State Building and the World Trade Center are responsible for interference to HP disk drives.)

There are no federal standards governing computer susceptibility to EMI. Indeed, it is not clear which agency would be responsible for such regulations.

Open Area Test Sites

By far the best attended session at the meeting was the workshop on open area test sites. With new FCC EMI requirements for devices with integrated circuits, there has been a movement towards improved techniques for measuring and characterizing radiated emissions. Manufacturers are striving for more standardized and reliable testing procedures to ensure that design changes are cost effective. Donald Heirman of Bell Labs in Holmdel, NJ, described the construction of an all-weather, open field test site. He stressed that they are not necessarily very expensive; his cost only about $60,000, excluding the price of real estate and instrumentation.

Edwin Bronaugh reviewed the work of the ANSI C63 Committee on Radio-Electrical Coordination of which he is the chairman. Subcommittee 1 is in the process of revising the C63.4 standard for the "establishment and characterization of open air test sites for EMC measurements." The eighth draft of the proposed revision is now up for a vote. A subcommittee meeting has been re-scheduled to consider the ballots and will now be held on November 3 at the FCC in Washington, DC. The full C63 committee will meet the following day. Bronaugh, who recently moved to Electro-Metrics in Amsterdam, NY, from the Southwest Research Institute in San Antonio, TX, said that he hoped that the C63.4 standard would be adopted early in 1983.

At the end of September, Leonard Thomas, Sr., the secretary of C63, said that it is possible that a ninth draft will have to be circulated among the subcommittee members before the proposal is presented to the full committee for a final vote.

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The date and location of next year's EMC meeting has just been changed. The 1983 symposium will now be held at the Hyatt Regency-Crystal City in Arlington, VA, on August 23-25. ●

HIGHLIGHTS

Reagan Signs Communications Bill: FCC Granted Authority To Set RFI Standards

As expected, President Reagan signed the Communication Amendments Act of 1982 into law on September 13. Public Law 97-259 authorizes the Federal Communications Commission (FCC) to set minimum performance standards for electronic equipment used in the home in order to reduce its susceptibility to radiofrequency interference (RFI). (See *MWN*, September 1982.) Among other provisions, the amendments allow the FCC to stop licensing CB radio operators and to simplify its procedures for issuing amateur radio licenses. The managing director of the FCC has appointed a task force to sort out the commission's responsibilities under the new law and to expedite its implementation.

The Senate and House had originally passed their own bills (S.929 and H.R. 5008). The differences between the two versions were reconciled in a House-Senate conference at the end of August: the resulting legislation (H.R. 3239) was approved by the President.

While the commission can now issue RFI standards, it does not have to do so. As the conference report (House Report No. 97-765) explains: "In view of complaints regarding home devices, the conferees believe that commission authority to impose appropriate regulations on home electronic equipment and systems is now necessary to insure that consumers' home electronic equipment and systems will not be subject to malfunction due to RFI. However, the legislation does not mandate [the] commission [to] exercise this authority; that decision is well within the technical expertise of the agency."

The final determination on whether or not to set standards lies with the commission's chief scientist. An FCC staffer said that the issue was still under review and that no decision has yet been made on how to proceed.

One expert predicted that the FCC would not move to set standards immediately. Lawrence Movshin, an attorney with McKenna, Wilkinson & Kittner in Washington, DC, told *Microwave News that he expects the commission to use the* new authority to press industry into adopting voluntary guidelines.

In the report accompanying the bill, the conferees preempt state and local action on RFI regulations. They state that only the FCC has the jurisdiction to deal with RFI incidents.

The original House bill (H.R. 5008) contained a provision that would have authorized independent laboratories to test *and* certify devices for their potential to cause RFI. The Computer and Business Equipment Manufacturers Association, among others, objected: companies were worried that conflicts of interest would arise if the FCC delegated its certification authority to private companies. The FCC agreed and withdrew the proposal. ●

EPA and OSHA Delay Health Standards

The release of advanced notices of proposed rulemaking (ANPRM) on new radiofrequency and microwave (RF/MW) radiation standards by the Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration (OHSA) have been delayed. Both agencies were scheduled to issue notices in September; EPA a guidance for general population exposures and OSHA a standard for occupationally exposed workers.

At EPA, the ANPRM is now in "red border" review. This is the last step in the agency's evaluation process when all proposals are examined by the senior EPA staff and are forwarded to Administrator Anne Gorsuch for a final decision. There is no word as to whether Gorsuch will sign the ANPRM. If she does, it would probably be published in the *Federal Register* in November. One EPA staff member said that if it is approved, the Office of Radiation Programs would still try to meet its original schedule of publishing a proposed rule in September 1983 and final guidance in September 1984.

At OSHA, a draft ANPRM will be submitted to agency management in mid-October. If approved without changes, it would take about 4–6 weeks to publish the notice. (In May, OSHA officially proposed to delete all its voluntary standards including its advisory 10 mW/cm^2 RF/MW standard.)

OSHA has received a report on the potential economic impacts of various occupational RF/MW standards from its contractor, Centaur Associates of Washington, DC. According to an OSHA staffer, the consulting firm's analysis is too sketchy to satisfy the Reagan Administration's executive order requiring that economic analyses accompany all major proposed rules. Due to budgetary constraints, OSHA has no plans to let another contract. The agency does not intend to release the Centaur report.

Work is continuing on the National Institute for Occupational Safety and Health's (NIOSH) criteria document on RF/MW radiation. While the timetable for its completion is not firm, a draft for internal review could be completed by the end of the calendar year. ●

Minnesota Advisory Panel Reviews DC Power Line Safety

A Minnesota scientific advisory panel investigating the health effects of high-power DC lines has concluded that there is no evidence they pose hazards. In a September 2 draft report to the Minnesota Environmental Quality Board (MEQB), the group reviews and rules out possible harmful effects from electromagnetic fields, air ions and electric shocks from the lines. A minority report appended to the draft, however, states that too little is known about air ions to issue safety assurances.

The investigation is part of a MEQB project for reevaluating the state's power line construction permit requirements. The board's efforts began several years ago in response to local opposition to the construction of a 430-mile, 800-kV DC line, which is now in operation between a North Dakota coal field and Minneapolis, MN. In addition to the panel's final report, MEQB will consider the results of an $86,000 retrospective study on the health and performance of dairy cattle near the line, underway at the University of Minnesota's College of Veterinary Medicine, and an interim report on the state's ongoing monitoring of the power line's electric fields and ion currents. The board will review permit requirements in December.

In the majority draft report, six out of seven panel members conclude that no new standards addressing power line safety are needed, though they do call for more research on air ions. They recommend that the state continue its monitoring program and that it offer support for an epidemiological study. The panel also notes that AC fields within the line's power-converter stations might affect pacemakers and asks the state's health department to evaluate this hazard.

Although the panel found "behavioral and biological effects have been reported in the literature at ion concentrations

$10–10^4$ times greater than ambient levels," it concludes that such exposure "at distances more than a few hundred meters from the conductors appears unlikely." It also states, however, that "there are insufficient data to determine what effects, if any, might be observed with exposures to high ion concentrations over extended periods of time." According to the report, "air ions and/or charged aerosols, measured as enhanced electric fields, can probably be carried downwind from the line for hundreds of meters before the fields dissipate to natural background levels."

In the minority report, panel member Dr. Robert Brambl concedes that there is no proof of ill effects caused by air ions but argues that the "uneven quality and limited quantity" of research makes risk assessment impossible. He recommends that air ion concentrations in the vicinity of the line "be reduced to ambient levels by any of several technical modifications of the transmission line that are now available."

The draft, which includes an executive summary, is now being circulated for review. According to George Durfee, manager of the MEQB's Power Plant Siting Program, a final report should be out in early November. An interim report on the state's monitoring program and the results of the dairy cattle study will also be out in November. ●

Do-It-Yourself Oven Checks

A southern California public library now offers borrowers more than books: a meter to check microwave ovens for radiation leaks. The Orange city library's El Modena branch has developed a lending program that makes reliable equipment available to oven owners.

Barbara Brotherton, the unit's librarian, came up with the idea after receiving a number of questions about microwave oven safety. The library purchased the HI-1501 meter and will lend it out with an easy to follow instruction booklet prepared by the manufacturer, Holaday Industries, Inc. of Eden Prairie, MN. The equipment cost the library less than $400.

Holaday's Burton Gran reports that the company now hopes to interest other communities in similar programs and is mailing information to 3,000 public libraries. The program "provides an excellent opportunity to educate the public about oven safety," he explained, "and of course, it also provides a new market for our product."

The HI-1501 can measure 2450 MHz radiation used for most microwave cooking at power levels from .01 mW/cm^2 (10 uW/cm^2) and up. The Bureau of Radiological Health has set acceptable emission limits for new ovens at 1 mW/cm^2 at a distance of 5 cm (2 inches) from the oven surface and at 5 mW/cm^2 for used equipment. ●

Industry Legal and Policy Seminar

The Electronic Industries Association (EIA), the Association of Home Appliance Manufacturers (AHAM) and the National Association of Broadcasters (NAB) are sponsoring a seminar on *RF Radiation: Legal and Policy Implications* to be held at the Homestead in Hot Springs, VA, October 27–29. The meeting is designed "to give participants an authoritative overview of problems caused by arousal of the public's fears of 'radiation,' and to consider how these problems, which confront manufacturers and users of electronic and electrical equipment, may be solved."

Dr. John Osepchuk of Raytheon, the organizer of the seminar, expects up to 150 people to attend. In a telephone interview he said that "people in industry, like the general public, need to be educated." Only in this way, he went on, "can we defend ourselves."

One of the major issues to be addressed at the meeting is the siting of new radiofrequency and microwave sources. Jules Cohen, a consulting engineer from Washington, DC, and Lt. Col. Peter Daley, an environmental advisor to the Secretary of the Air Force, will review commercial and military siting problems.

In the letter of invitation, EIA Vice-President John Sodolski states that there is an "irrational fear" of radiation from 60 Hz to the higher microwave frequencies: "The organizers of this seminar believe that this 'radiation fear' phenomenon is based primarily on unfounded allegations of scientific fact and rumors, and on irresponsible behavior by a few individuals in both the media and professional communities. We believe that to preserve the health of US electrical technology and its use by society, responsible manufacturers and users must take steps aimed at positive objectives in the areas of public policy, regulation, scientific research and public education." And, "If, as we believe, there is no scientific basis for many of these fears, then it is important that we present a vigorous defense in radiation litigation actions, encourage rational government actions, support sound research and help bring about public education in this area."

One possible approach suggested by Sodolski is the formation of an alliance among manufacturers and users patterned on one set up in response to a move to ban chlorofluorocarbons. These chemicals, used in refrigeration equipment and aerosol cans, are believed to cause the catalytic destruction of the earth's ozone layer. The degree of depletion is uncertain and is the subject of intense scientific debate. A detailed proposal for such an alliance on radiofrequency and microwave radiation will be presented at the meeting.

Among the attorneys scheduled to discuss litigation strategies are AT&T's Christopher Mills, Richard Bennett of Bennett & Bennett, NY Telephone's Saul Scheir, Bell Labs' Godfrey Preiser, Raytheon's William Van Gemert and Pacific Telephone & Telegraph's Roger Downes.

Attendance at the meeting is by invitation only and costs $250. In an effort to encourage a free exchange of ideas on this "sensitive subject," the seminar will be closed to the press and all cameras and recording equipment will be banned from the meeting rooms. A similar seminar was held last year (see *MWN*, June 1981). ●

UPDATES

Biological Effects... Dr. Jim Toler of the Georgia Institute of Technology has been awarded $71,000 by EPA to develop a new dosimetry system for his chronic study of the effects of 500 MHz radiation. Toler has developed a new type of radiation exposure facility involving circular, parallel waveguides stacked in a tier arrangement. These will be housed in a converted grain silo, which has the advantage of allowing easy control of its temperature and humidity. According to present plans, Toler's team will run a lifetime study of 95 rats exposed to unmodulated 500 MHz fields; 95 control rats will be housed in a similar silo. They will then attempt to discover the causes of death. The level of exposure is tentatively set at 10 mW/cm^2, though no decision will be made until a pilot study is completed. The preliminary experiment could start this winter, and the full study could get under way by next summer or fall.... The AF School of Aerospace Medicine at Brooks AFB, TX, has contracted with the University of Utah for a 15-month research project on the biological effects of millimeter radiation—in the 26.5 to 90 GHz frequency range. The work, which is a continuation of a previous effort, involves the measurement of

physical quantities such as complex permittivities of biological materials at these frequencies. Professor Om Gandhi is the principal investigator....On another front, the AF has just received a number of proposals in response to a request for a survey of RF interactions with biological systems, with special emphasis on where the interactions might occur....The Plenum Publishing Co. in New York City has issued *Biological Effects and Dosimetry of Non-Ionizing Radiation: Radiofrequency and Microwave Energies.* The volume, the proceedings of a NATO Advanced Study Institute meeting held in Erice, Sicily March–April 1981, was edited by Dr. M. Grandolfo at the Superior Institute of Health in Rome, Italy; Dr. S. Michaelson of the University of Rochester; and Dr. A. Rindi of the National Institute of Nuclear Physics in Rome. The 650-page book costs $79.50 in the US and Canada and $95.40 elsewhere.

Communications...Onondaga, NY, has extended its moratorium on new broadcast sources in order to develop a town RF/MW exposure standard. (See Standards Update.)...A local suit to block construction of ITT's proposed 20-watt relay tower in Coventry, CT, is now expected to come before the state's Superior Court in November at the earliest. Although community concern has focused on microwave health hazards, the case will address zoning board procedures. The board approved the tower on April 20. (See *MWN,* June and September 1982.)...The FCC's Private Radio Bureau has published a *Private Microwave Licensing Policy Study,* August 1982, which reviews current rules and examines possible deregulatory actions. A limited number of copies are available from the FCC's Office of Public Affairs, Room 207, 1919 M Street, NW, Washington, DC 20554, (202) 254-7674. Otherwise, they can be purchased from the Downtown Copy Center, 1114 21st Street, NW, Washington, DC 20037, (202) 452-1422....Three competing transmission systems for stereo TV are compared in the September *IEEE Spectrum.* The US Electronic Industries Association (EIA), which has tested the systems, plans to recommend one to the FCC as a transmission standard. An EIA report, *Multichannel Television Sound: the Basis for Selection of a Single Standard,* Vol. 1, is available from the EIA, 2000 I Street, NW, Washington, DC 20006....Comments submitted on the FCC's proposed allocation of 6 MHz for shared fixed services use by government and others are outlined in the August 30 *Broadcasting.* ...In its September 20 issue, the magazine summarizes industry response to the FCC's proposal for creating more FM radio slots....A report on electronic espionage and the Soviet-owned estate in Glen Cove, NY, appears in the September 3 *Science.* In "Evading the Soviet Ear at Glen Cove," William Broad notes that this post on Long Island could easily be used to monitor the busy communications traffic along the Northeastern seaboard....Those interested in this subject are referred to James Bramford's new book, *The Puzzle Palace: A Report on NSA, America's Most Secret Agency,* published by Houghton Mifflin Co. in Boston, MA ($16.95)....The September-October 1982 issue of *Radio Science* features a collection of papers on "Mathematical Models in Radio Propagation." These papers were originally presented at a symposium held in conjunction with the XXth URSI meeting in Washington, DC, in August 1981.

Compatibility and Interference...The FCC has decided to re-classify coin-operated electronic games from Class B to Class A computing devices, subject only to verification by the manufacturer. Despite reports of interference from electronic games, mostly to land mobile radio communications, the commission loosened the rules because it believes that Class A restrictions should be sufficient to protect communication receivers. But the FCC did move up the date for compliance as compared to other Class A computing devices: all coin-operated games manufactured after December 1, 1982 must be verified before marketing. The commission warned, however, that if Class A restrictions are found to be insufficient it will initiate rule making to impose Class B requirements. The FCC advises that it "will be closely monitoring this situation for the next year or so."... In a related decision, the FCC has denied a petition by Texas Instruments to classify hand-held electronic games according to their clock frequency. The commission concluded that clock frequency alone does not determine the potential for interference. Hand-held games manufactured after October 1, 1983, must be verified for compliance with Class B rules....The National Association of Broadcasters (NAB), among others, has filed comments with the FCC on a petition from RF Power Labs to allow a wireless security system to operate at UHF-TV frequencies. The NAB cites the dangers of interference to low-power TV stations....On August 30, the FCC detected "appreciable" power increases in AM broadcasts from Cuba on 570 kHz, 670 kHz, 1040 kHz, 1160 kHz and 1380 kHz. Of the 96 AM stations that could have been affected, only WHO in Des Moines, IA, complained that the Cuban signals caused interference....The Senate Foreign Relations Committee approved plans for Radio Marti (S.1853) by a vote of 11–5 on September 9. The measure now awaits action by the full Senate. A companion bill (H.R. 5427) has already passed the House....Attendees at the *International Conference on Electromagnetic Compatibility,* organized by the Institution of Electronic and Radio Engineers in England, were scheduled to hear Dr. J. M. Thomson of the Royal Aircraft Establishment in Farnborough deliver the keynote address on "Research on EMC for Aircraft Systems," at the University of Surrey on September 21. Among the other papers to be presented were "The Interference Effects of Citizen Band Radio," by A.C.D. Whitehouse of the Home Office and "The Susceptibility of Analog Circuits to Radiofrequency Interference: Prediction and Measurement," by M. Elliot of A&AEE, Boscombe Down.

Government...The Bureau of Radiation Control (BRC) at the Texas Department of Health in Austin, TX, held a five-day workshop on *Radiofrequency Electromagnetic Principles and Survey Techniques for Health Physicists,* August 23–27. Experts from EPA, BRH and OSHA participated in the training program. According to the bureau's Suzy Kent, the BRC now has 16 field inspectors who can monitor both X-ray and non-ionizing radiation sources, including microwave ovens, RF sealers and heaters, broadcast communications sources and medical devices like diathermy machines. The workshop attendees were taught how to use Narda and Holaday meters. Kent said that the BRC intends to buy an Instruments for Industry meter to measure low frequency radiation....The FCC has issued its *47th Annual Report/Fiscal Year 1981.* It presents a wealth of details on the commission's many programs. The report (No. 004-000-00395-1) is available from the Government Printing Office, Washington DC 20420, (202) 783-3238. The price had yet to be determined at press time.

International...The National Institute of Environmental Health Sciences (NIEHS) has published the *Proceedings of [the] US-USSR Workshop on Physical Factors: Microwaves and Low Frequency Fields,* dated April 1981. The workshop was held at the University of Washington, Seattle, in June 1979. Copies are available from Dr. Donald McRee, NIEHS, PO Box 12233, Research Triangle Park, NC 27709....The National Radiological Protection Board (NRPB) has issued a report, *The Work of the NRPB 1977/80 and a Review of the First 10 Years.* Though focussing mainly on ionizing radiation, the report does include a brief review of the board's work on non-ionizing radiation. Contact: NRPB, Chilton, Didcot, Oxfordshire OX11 ORQ, United Kingdom.

Measurement... EPA has published a summary of its *Radiofrequency Measurements Workshop,* held in Las Vegas, NV, November 3–5, 1980. The report presents observations on a number of RF/MW meters, including those manufactured by Holaday, Instruments for Industry, Narda and General Microwave. The workshop participants conclude that, "At present, the state of the art of electromagnetic survey instrumentation and survey techniques is such that under certain conditions, valid measurements can be made; however, a general statement about the validity and reliability of such measurements under all conditions cannot be made because of the following problems: (1) Published instrument specifications are generally incomplete; e.g., it is often unclear as to the applicability of frequency response data at frequencies where the instrument was not calibrated and there is usually no indication as to out-of-band performance or susceptibility to interference from radiofrequency signals (RFI) by the instruments. (2) Published instrument specifications are often unreliable; e.g., the response of individual instruments does not always

agree with the calibration provided by the manufacturer. (3) Measurements are often made under uncontrolled and/or unknown conditions. (4) Measurements are often made with instrumentation and/or techniques inappropriate to the conditions present at the time and location of the measurement. (5) In general, there is a lack of suitably calibrated antenna, for various regions of the spectrum, that can be used for spatial characterization of the electromagnetic environment in a given frequency domain." They recommend that a group such as ANSI set standards for minimal uniform reporting of performing characteristics and for minimal testing procedures for existing meters and for performance characteristics of future ones. And that, "Standardized measurement techniques be developed based on existing instrumentation, applicable standards and exposure situations." The 14-page report, No. EPA 520/2-82-010, July 1982, will be available from the National Technical Information Service, Springfield, VA 22161, though its NTIS order number and price have not yet been assigned .... The September issue of *Test & Measurement World* features a chart of many RF/MW spectrum analyzers, listing their key operating characteristics.... The Continuing Education Institute is sponsoring a short course on *Microwave Theory and Measurements* to be held in Columbia, MD, on November 2-5, and in Palo Alto, CA, on November 30-December 3. The course will be taught by Dr. Stephen Adams of Hewlett Packard; the fee is $750. For more information contact CEI, 10889 Wilshire Blvd., Los Angeles, CA 90024, (213) 824-9545 .... NBS has prepared *A Bibliography on Laboratory Accreditation* (No. NBSIR 82-2523), a compilation of references from 16 countries. It is available from NTIS (see above) for $12. Order No. PB 82-237694.

Medical Applications...Two researchers working in London have investigated the effects of pulsed electromagnetic fields (PEMF)—the type used to heal non-union fractures—on the nerve cells of rats. In the August 21 issue of *Lancet*, A.R.M. Raji and Ruth Bowden indicate that they have found "significant evidence that PEMF has no effect on healthy nerves but that beneficial effects are obtained in treating degenerating and regenerating nerves after crushing (and after section and primary suture) of nerves in rats." They suggest as a possible mechanism an increase in blood flow, though they recommend more studies: "There is a need for carefully controlled clinical trials of the effects of PEMF upon the degree and quality of functional recovery after peripheral nerve injuries in man."...Writing in the *Journal of the American Medical Association* (August 27), a doctor from Hawaii raises his concern about a recent paper by Dr. Andrew Bassett and co-workers that reported successes in healing non-union fractures with PEMFs. (See *MWN*, March 1982.) He recommends a controlled double-blind study on the safety and efficacy of using PEMF treatments to ensure that they are preferred over spontaneous healing; he also questions their cost effectiveness. Bassett's team responds that many of the fractures cited in his original report had not healed spontaneously—a group of 332 patients had an average disability time of 4.7 years, and in 29 percent of the cases at least one orthopedic surgeon had recommended amputation. They do point out, however, that such a double-blind study is now underway in the United Kingdom. With respect to cost, they note that a financial analysis by an insurance company had found that "PEMF treatment reduces medical costs to a greater extent than any other therapeutic plan, short of a simple plaster cast and crutches." The study cited by Bassett is being carried out at a number of research centers in the UK and is being coordinated by Electro-Biology International (UK) Ltd. in Reading....The National Cancer Institute (NCI) wants to develop guidelines for the use of NMR imagers. The institute plans to have a contractor compare NMR to other diagnostic imaging techniques. RfP NCI-CM-37564-27 is scheduled for release at the end of September with proposals due on December 1....The Plenum Publishing Co. in New York City has issued a new book, *Hyperthermia and Cancer*, by George Hahn of Stanford University Medical Center. The 275-page book costs $35.00 in the US and Canada and $42.00 elsewhere .... More than 200 papers were presented at the first *Southern Biomedical Engineering Conference* held in Shreveport, LA, last June 7-8. Abstracts of the papers are published in *Biomaterials, Medical Devices and Artificial Organs*, Vol. 9, Number 4, 1981 ....The Association for the Advancement of Medical Instrumentation recorded the technical sessions at its annual meeting. Cassettes on NMR imaging and hyperthermia therapy for cancer, among many other subjects addressed at the May 9-12 conference, are available from Eastern Audio Associates in Columbia, MD, (301) 596-3900. They are $16.00 each....The Office of Technology Assessment has released a report, *Strategies for Medical Technology Assessment*, critical of current methods of evaluating the safety, efficacy, cost and social impact of medical systems. The report (No. 052-003-00887-4) is available from the Government Printing Office, Washington, DC 20052 for $7.50....When using NMR machines, be careful: the fields can demagnetize your credit cards, making them useless.

Military Systems...The air force has identified possible sites for its West Coast Over-the-Horizon Backscatter (OTH-B) radar and will evaluate them in a draft environmental impact statement (EIS) to be prepared by SRI International. The AF will consider two different locations near Christmas Valley, OR, for the radar transmitter and two sites 35 miles from Alturas, CA, for the OTH-B receiver. The transmitter site will require about 1000 acres and the receiver site about 700 acres. Possible locations for the operations center include Kingsley Field, OR; Mountain Home AFB, ID; McClellan AFB, CA; and McChord AFB, WA. The AF plans to have the draft EIS ready for public review in early 1983 ....The navy is contending that a House Appropriations defense subcommittee is forcing it to spend more than $85 million on a phased array radar system it does not want, according to an item in the September 14 *Washington Post*. The X-band radar for the Mark 92 fire control system aboard the navy's FFG7 frigate is being built by the Sperry Corp. in Great Neck, NY. The measure is supported by Congressman Joseph Addabbo (D-NY), the chairman of the subcommittee who represents a constituency near the Sperry plant....The Coast Guard has announced that the eighth and final OMEGA station went into operation in mid-August near the town of Woodside in southeast Australia.The OMEGA Navigation System uses a very low frequency signal (10.2-13.6 kHz) to provide ships and aircraft with a means of determining their location anywhere in the world to an accuracy of two to four nautical miles. Other OMEGA stations are already in operation in North Dakota and Hawaii, and in Argentina, France's Reunion Island, Japan, Liberia and Norway. The Coast Guard is in the midst of a study to verify the overall system's accuracy and extent of coverage....By the end of the decade, DoD plans to have its Navstar satellite navigation system in operation. Meanwhile, *Aviation Week & Space Technology* (August 30) reports that the USSR is planning its own system which is nearly identical to Navstar....The September 20 *Businessweek* features a cover story on "Killer Electronic Weaponry," with details on how the Israelis knocked out Syrian radars during the invasion of Lebanon....The Association of Old Crows is set to meet in San Francisco, CA, October 12-14. The symposium will highlight the latest developments in electronic warfare.

Mobile Communications ... The FCC's recently released interim report, *Future Private Land Mobile Telecommunications Requirements*, predicts a substantial excess demand for services by 1990. In addition to evaluating the future market, the report reviews the spectrum currently available for mobile communications and the potential sources for additional capacity. Comments on the draft are due November 19. A limited number of copies are available from the FCC's Office of Public Affairs, (202) 254-7674....A flood of major amendments to cellular applications received on June 7 has slowed down processing and has prompted the commission to stop accepting new filings for the time being....The commission published its final rules on releasing the remaining frequencies in the 806-821 and 851-866 MHz bands for private land mobile radio services (PLMRS) in the September 16 *Federal Register* (47 *FR* 41002)....The final FCC action allocating frequencies in the 928-941 MHz band for PLMRS appears in the September 8 *Federal Register* (47 *FR* 39502).

Occupational Health ... OSHA's Training Institute in Des Plaines, IL, outside Chicago, has expanded its facilities. The institute features a non-ionizing radiation laboratory....The Continuing Engineering Studies program at Northwestern University's Technological Insti-

tute is sponsoring a course on *Radiation Safety* in Evanston, IL, November 15–19. The short course, which addresses both ionizing and non-ionizing radiation issues, will be taught by the university's Dr. Herman Cember. The fee is $650. For more information, contact the institute at (312) 492-3365.... And the Rocky Mountain Center for Occupational and Environmental Health at the University of Utah is hosting a three-day course, *Current Issues and Trends in Controlling Occupational Exposures to RF/Microwave Radiation,* next February 8–10. OSHA's Robert Curtis will be the instructor, the fee is $350. Contact: Ms. E. Hunt at the center, (801) 581-5710.

Ovens...Janette Marshall has a look at the use of microwave ovens in England in a two-part article in the July and August issues of *Here's Health.* Only two and a half percent of British homes (about 700,000) now have microwave ovens, but sales are jumping—almost doubling between 1980 and 1981 from 130,000 to 240,000—and projections indicate that as many as 20 percent of the households will use microwaves for cooking by 1990. Marshall discusses oven performance and preferred utensils and reviews the microwave safety issue. *Here's Health* is offering a four-page "Microwave Guide" which gives details on ovens available in England. It is available from the magazine for 50 pence (less than $1.00) at 30 Station Approach, West Byfleet, Surrey, England....The Single Service Institute (SSI) has put together a guide to using disposables in microwave ovens. For a copy contact: Nancy Culotta, SSI, 1025 Connecticut Ave., NW, Washington, DC 20036, (202) 347-0020....A team from BRH has published a paper on "Spatial Distribution of Microwave Oven Leaks," in the June 1982 issue of the *Journal of Microwave Power*....Some 382,600 microwave ovens were shipped from factories in August 1982, according to the Association of Home Appliance Manufacturers. Though this is an almost five percent decline from August 1981, it represents an increase of 50,000 units over factory shipments in July 1982.

Power Lines...The New York State Overhead Power Lines Project has received a $198,600 grant from the Department of Energy (DOE) to aid its investigation of power line radiation health effects. Greg Alvord, the project's newly appointed Scientific Research Coordinator, reports that the grant will help pay for three consulting engineers hired to evaluate and monitor dosimetry in studies funded by the project. This spring, the scientific advisory panel for the $3.5 million program awarded 15 contracts for two- and three-year research studies. (See *MWN,* April and May 1982.)...The USDA Forest Service is looking for a contractor to study the effects of a 500 kV transmission line on elk near Butte, MT. According to its RfP (R1-11-82-140), the service wants to know what will happen to the animals' winter home as a result of the construction and operation of a line along the North Boulder River.

Radar....The FCC is threatening to force the Speed-O-Matic Co. of Harbor City, CA, to take one of its products, which helps speeders evade traffic tickets, off the market, according to the September 22 *Washington Post.* The device was originally intended to tell a driver his speed by emitting high frequency signals. The FCC contends that Speed-O-Matic has modified it to interfere with police radar so that it appears as if the car is going slower than its true speed....Among the papers scheduled to be presented at the *Radar-82 International Conference* in London, October 18–20, are "An Experimental Microwave Phased Array Radar" by a group from the Beijing Institute of Radio Measurement in China, "The Dolphin Naval Surveillance Radar" by Dr. J. Blogh of Plessey Radar Ltd., and "HF Sky Wave Backscatter Radar for Over-the-Horizon Detection" by G.R. Nelson and Dr. G.H. Millman of General Electric (US)....The Georgia Institute of Technology's Department of Continuing Education in Atlanta is sponsoring a week-long short course on *Principles of Modern Radar,* November 15–19. The fee is $525. For more information call: (404) 894-2400.

Satellite Communications ... RCA's planned satcom station near Seattle continues to meet community resistance. Residents of the Indianola-Kingston area, now the primary site proposed by RCA's Americom subsidiary, are appealing a Kitsap County hearing examiner's recommendation for approval. The Board of County Commissioners will hold an appeal hearing in early October. RCA originally planned to put the station on Bainbridge Island but met well-organized local opposition. (See *MWN,* July/August 1982.)...The EIS for Teleport, a satcom complex sponsored by the Port Authority of NY and NJ and Merrill Lynch, is set for release in mid-October. (See *MWN,* June 1982.)... Comsat has received FCC approval to begin building DBS facilities. Eight other applications will receive FCC attention this month....The commission's decision to allow Comsat to compete in international communications markets and its proposed restructuring of the company to separate its competitive and monopoly activities are outlined in the September 17 *Federal Register* (47 *FR* 41116)....International Resource Development Inc., of Norwalk, CT, has published *Direct Broadcast Satellite Systems.* The market research study sells for $985 and is available from IRD, (800) 243-5008.... *New Scientist* features satellite TV as the cover story in its September 9 issue.

Standards...The town of Onondaga, NY, has decided to adopt its own RF/MW exposure standard. On August 16, the town board extended its moratorium on new broadcast sources, begun in 1980, and told the Onondaga Environmental Advisory Council to develop recommendations for general population exposure rules. According to Ray D'Agostino, the town's attorney, the board had expected a federal standard to be out by now and was tired of waiting. D'Agostino said the environmental council will now look into various local standards, including Multnomah County's (OR), and review the new ANSI standard. The moratorium began shortly after Filmways Communications of Syracuse, NY, proposed building a TV station in Onondaga. The company has since filed suit in the US District Court for Northern New York seeking more than five million dollars in damages from the town....Massachusetts' final draft standard for RF/MW radiation exposure for the general population is out for review. The proposed rule is five times stricter than the new ANSI standard and sets a 200 uW/cm^2 exposure limit for the 30–300 MHz frequency band. Unlike an earlier version, the draft standard does not address occupational exposures and is limited to fixed radiation sources. (See *MWN,* March and April 1982.) A public hearing on the proposal is scheduled for November 29 in Boston. Another hearing will be held in the western part of the state on December 2. For copies of the draft and for more information on the hearings, contact: Radiation Control Program, Room 770, 600 Washington Street, Boston, MA 02111, (617) 727-6214 .... ANSI has published the new "Radiofrequency Radiation Hazard Warning Symbol" (C95.2-1982). (See *MWN,* October 1981.) A copy is available for $5 from ANSI's Sales Dept., 1430 Broadway, New York, NY 10018.... DoD has joined ANSI as a governmental member....The International Electrotechnical Commission (IEC) has issued two draft rules: "CISPR/C (Central Office) 29, Document CISPR/C (Secretariat) 36: Manual on interference from overhead power lines and high voltage equipment, Clause 8: Limits on interference, Sub-clause 8.1: Definition of nuisance limits, Sub-clause 8.3: Methods for derivation of limits;" and "CISPR/D (Central Office) 8, Amendments to CISPR Publication 12" on interference relating to motor vehicles and internal combustion engines." In addition, the IEC has published a standard, IEC 725-1981, on EMC between electrical equipment: "Considerations on reference impedances for use in determining the disturbance characteristics of household appliances and similar electrical equipment." These are also available from the ANSI Sales Office.

VDTs...Another VDT worker at Surrey Memorial Hospital in Vancouver has miscarried, bringing the number of abnormal pregnancy outcomes among the accounts department employees to six out of seven. Since terminals were installed in 1978, three women have miscarried, two babies were born with health problems and one birth was premature. (See *MWN,* July/August 1982.) The union has hired Dr. Hari Sharma of the University of Waterloo in Ontario to check the terminals for non-ionizing and ionizing radiation and to take air samples in the room..... An August 2 *Computerworld* editorial on VDT's and pregnancy problems focuses on managing worker stress. It states, "Overexposure to [VDTs] can lead to stress in the form of headaches and eyestrain, both of which were reported by the British

UPDATES: VDTs *(continued)*

Columbia hospital workers. NIOSH admits that stress could be a factor in pre- and postnatal problems." The editorial concludes, "Innovative employers are finding ways to regulate [VDT] exposure and maintain office productivity. It is time for *all* employers with [VDT] terminals to follow their lead."...Union officials at District 65 of the United Autoworkers Union in Boston, MA, are worried about the effects of VDTs on pregnant women. Over the last 3–4 years, three women in the keypunch department at Boston University (BU) have had four problem pregnancies. One of the women miscarried and then stopped work during a subsequent pregnancy; she had a healthy baby. One woman had premature contractions in her fifth month of pregnancy; she left work and later had a healthy baby. A third woman became sick while pregnant and left the university; the union has not been able to follow up on her pregnancy. According to Ferd Wulkan of District 65, the local has written to BU management requesting that women be taken off VDTs during pregnancy. The union is also concerned about the eyesight of VDT operators. During recent eye examinations, 20 percent of some 100 women working on VDTs for at least 45 percent of their time were referred for further testing. Wulkan said that, although the union does not know the specifics on all these complaints, the eye problems appear to require more than new glasses to correct....A draft report from the Labor Education and Studies Center of the Canadian Labor Conference in Ottawa has recommended a long-term study on VDT health effects. The report concludes: "Measures to detect any adverse reproductive outcomes in VDT workers and to determine what the causative agent(s) might be must be undertaken at once." Publication of *Towards a More Humanized Technology* is scheduled for this month....The Ontario Public Service Employees Union has challenged the validity of VDT radiation tests taken at Toronto's Old City Hall by the Ontario Ministry of Labor. Ten out of 19 pregnant women working in the building for the provincial attorney-general's office miscarried in 1980–81. (See *MWN*, April 1982.) The union's Robert DeMatteo has asked Ontario's Director of Occupational Health and Safety for new tests and for shields for the VDTs....The Washington State Labor Council has established a VDT committee and plans to set up a VDT resource center at the council's Seattle office. For information, contact the council's Karen Kaiser (206) 682-6002....The New York Committee for Occupational Safety and Health (NYCOSH) is sponsoring a conference on the *Health Hazards of Office Work* on November 20 in New York City. For information, contact NYCOSH, (212) 674-1595....A summary of the National Research Council's August 1981 Symposium on VDTs and the Vision of Workers has been published in *Behaviour and Information Technology*, Vol. 1, No. 2, 1982. (See *MWN*, September 1981.) The report states: "NIOSH and the Food and Drug Administration's Bureau of Radiological Health have found no evidence of radiation hazards in operating VDTs. Routine radiation surveys appear unwarranted, however NIOSH is continuing limited field surveys and will continue to survey new design technology to ensure that there are no significant changes in radiation emission."...Doctors at the VA Medical Center in Washington, DC, have warned that old color TV sets when used as VDTs for personal computers may expose children to hazardous levels of X rays. In a letter appearing in the September 30 *New England Journal of Medicine*, Drs. David Nashel and Louis Korman and John Bowman report that people using color sets made prior to 1970 for two hours a day could receive radiation doses of 779 mrem to the thyroid and 890 mrem to the lens of the eye per year. This exposure was calculated for a viewing distance of 40 cm with an exposure rate at the face of the tube of 2.7 mR per hour. The National Council for Radiation Protection and Measurement recommends an exposure limit of 100 mrem per year for people under 18 years old. The authors note: "Since radiation intensity is a function of distance from the emitting source, the spatial separation of viewer and display screen is extremely important." To decrease the chance of excessive exposures, they suggest that "only newer color television receivers (those manufactured after January 15, 1970) be used as display elements for computer function."...*The Ergonomics Newsletter* has begun publication. Topics on the office include R&D, standards and product evaluations. The cost per year (at least six issues) is $126. Contact the Koffler Group, (213) 459-4429.

CONFERENCE CALENDAR

• October 17–20: 1982 *IEEE Military Communications Conference*, Stouffer's Bedford Glen Hotel, Bedford, MA. Contact: Lawrence Jeffery, MITRE Corp., PO Box 208, Bedford, MA 01730.

• October 18–20: *Radar-82*, Royal Borough of Kensington and Chelsea Town Hall, London, England. Contact: Institution of Electrical Engineers, Savoy Place, London, WC2R 0BL, England.

• October 20–22: *Military Microwaves '82*, Cunard International Hotel, London, England. Contact: Roger Marriott, Microwave Exhibition and Publishers Ltd., Convex House, 43 Dudley Road, Tunbridge Wells, Kent TN1 1LE, England.

• October 26–28: 1st *International Symposium on Medical Imaging and Image Interpretation*, Berlin, West Germany. Contact: Dr. Judith Prewitt, c/o IEEE Computer Society, PO Box 639, Silver Spring, MD 20901.

• October 30: *Conference on Environmental Ions and Related Biological Effects*, Drexel University, Philadelphia, PA. Contact: American Institute of Medical Climatology, 1023 Welsh Road, Philadelphia, PA 19115.

1983

• January 5–7: *National Radio Science Meeting*, University of Colorado, Boulder, CO. Contact: T.E. VanZandt, NOAA/ERL/R445, 325 Broadway, Boulder, CO 80303.

• February 14–19: 7th *International Conference on Infrared and Millimeter Waves*, University of St. Jerome, Marseille, France. Contact: Kenneth Button, National Magnet Lab, MIT, Cambridge, MA 02139.

• March 8–10: *Microwave Systems Applications Technology*, Sheraton Washington, Washington, DC. Contact: Richard Hartman, EW Communications, 1170 East Meadow Drive, Palo Alto, CA 94303.

• March 8–10: 5th *Electromagnetic Compatibility Symposium and Technical Exhibition*, Zurich, Switzerland. Contact: Dr. T. Dvorak, EMC-83, ETH Zentrum-IKT, 8092 Zurich, Switzerland.

• April 5–8: *International Magnetics Conference*, Franklin Plaza Hotel, Philadelphia, PA. Contact: F.J. Friedlander, School of Electrical Engineering, Purdue University, W. Lafayette, IN 47907.

• May 2–5: *Test & Measurement World Expo*, Convention Center, San Jose, CA. Contact: Meg Bowen, Conference Director, 215 Brighton Avenue, Boston, MA 02134.

• May 22–25: 18th Annual *Meeting of the Association for the Advancement of Medical Instrumentation*, Loews Anatole, Dallas, TX. Contact: AAMI: 1901 N. Fort Myer Drive, Arlington, VA 22209.

• May 23–26: *International IEEE/APS Symposium and National Radio Science Meeting*, University of Houston, TX. Contact: Professor Liang Shen, Department of Electrical Engineering, University of Houston, TX 77004.

• June 13–17: 5th Annual *Bioelectromagnetics Society Meeting*, University of Colorado, Boulder, CO. Contact: BEMS, 1 Bank Street, Gaithersburg, MD 20878.

• June 21–23: *International Aerospace and Ground Conference on Lightning and Static Electricity*, Fort Worth, TX. Contact: Nick Rasch, FAA Technical Center, ACT-340, Atlantic City Airport, NJ 08405.

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

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MICRO WAVE NEWS

Vol. III No.8 A Monthly Report on Non-Ionizing Radiation October 1983

INSIDE...

HIGHLIGHTS pp.4-8

NMR: More than Spectroscopy and Imaging

RTCA To Study RFI on Aircraft

GTE Sprint Sues Over Local RF/MW Law

US Union Wins Alternative Work for Pregnant VDT Users

BEMS'83: Part II

Spectrum Static: Radio & TV RFI

EXCERPTS p.3

Comments on EPA's External Review Draft Report on RF/MW Bioeffects

UPDATES pp.9-12

ASTM RFI Emergency Standard ▫ Birth Defects and RF Heating ▫ CBEMA Challenges VDT Claims ▫ Millimeter Waves Symposium ▫ Project ELF Litigation ▫ Notes on NMR ▫ Non-Linear Interactions ▫ RFI from ISM Sources ▫ Report on ELF & RF from VDTs ▫ Coleco Certification ▫ CSA Work on Ergonomic Guidelines ▫ Corrections ▫ and more...

Conferences p.8

Short Courses p.12

Classifieds p.11

Microwave News invites readers to contribute letters or reports for *From the Field*, our monthly column featuring news and opinions from the RF/MW community.

SAB Panel Wants Changes in EPA RF/MW Bioeffects Report

The Environmental Protection Agency's (EPA) draft report on the biological effects of radiofrequency/microwave (RF/MW) radiation will undergo significant revision before a final version is approved. Responding to criticisms from a special review panel, the agency's Office of Research and Development (ORD) has agreed to rewrite its assessment of thermal risks, the backbone of the report.

EPA will use the three-volume literature review and assessment as the basis for a general population exposure standard for RF/MW radiation. The agency's Office of Radiation Programs (ORP) had hoped to release a draft of this "guidance" in September but is now unlikely to publish a proposal until next year. (The EPA guidance will be binding only for federal agencies.) Problems in setting up a Scientific Advisory Board (SAB) panel to evaluate the draft report contributed to the delay in ORP's schedule.

The SAB panel met to discuss the draft report on September 22-23 in Washington, DC. Despite its request for major changes, the panel asked ORD's Dr. Joe Elder, the principal author of the bioeffects document, to complete the revisions by December. Elder said the schedule is optimistic but possible. Elder was "very pleased" with the meeting, stressing that "the bottom line is that ORP has something to use to move forward with the guidance."

Controversy Over Thermoregulatory Thresholds

The panel's section-by-section review went smoothly until it reached Section 4.1 on thermal physiology, prepared by ORD's Dr. Christopher Gordon. The panel found the analysis generally inadequate and directed special criticism at Gordon's extrapolation of thermal threshold response in animals to humans. Several panel members told Gordon that humans are better thermoregulators than the report indicates. The panel as a whole asked Gordon to rewrite the section and several members asked him to recalculate the thresholds using data from different animal experiments and human models.

The debate over thermoregulation was complicated by Dr. Eleanor Adair's criticism that it is impossible to extrapolate from animals to humans in this area. Elder told *Microwave News* that it is too early to tell what effect Adair's opinion will have on either ORD's revisions or the guidance. The onset of thermal effects is one of three approaches used in the report to identify thresholds.

Elder agreed to revise the assessments in Section 6 of the report which are based on Gordon's work. Drs. Barbara Chang, Sol Michaelson and Adair were particularly upset by the conclusion that the thermal activation

(continued on p. 2)

point for humans, calculated in terms of specific absorption rates (SARs), would be approximately 0.27 to 0.81 W/Kg. This translates into power density exposures of 1.2 to 2.6 mW/cm^2 at resonant frequencies.

The panel's criticisms are echoed in written comments submitted to the SAB by John Mitchell of the Air Force School of Aerospace Medicine and to EPA by John Bergeron of General Electric (see excerpts on p.3).

Panel members were fairly pleased with the rest of the report, except for a subsection on the nervous system which must be rewritten. The contributing authors attending the meeting were generally receptive to the panel's recommendations.

Key Issues

Early in the meeting, Elder asked the panel to consider several key issues in the course of its review, starting with the adequacy of the data base. Most panel members felt that, however incomplete the data, a standard must be set. They went on to discuss whether ORD should have assessed which RF radiation effects are hazardous instead of simply describing where and at what levels the effects occur.

ORP's Dr. David Janes, who is heading EPA's guidance development, told the panel this issue is not up for debate; ORP will make this assessment and consider it, along with a number of other factors, in setting exposure limits. Janes reported that the limits in the draft guidance "are not sufficiently in hand to discuss at this time."

Elder also asked how ORD should handle literature published after 1980, the cutoff date for most of the material included in the report. He said his group considered this issue at an August meeting and found that recent data "substantiated" the conclusions in the report and "served to reinforce the general conclusion that the data base is becoming more solid and more quantitative."

Dr. Michael Marron of the Office of Naval Research briefed the panel on experiments underway at Johns Hopkins University's Applied Physics Lab which indicate the endothelial layer of the cornea can be damaged by pulsed 2450 MHz radiation at power densities below 10 mW/cm^2. He said the work by Henry Kues and co-workers also provides evidence of cumulative RF/MW radiation effects (see *MWN*, July/August 1983).

Elder cited two human studies completed after 1980. In one, first reported in 1981, Dr. William Morton of Portland, OR, found a correlation between RF/MW levels and the incidence of leukemia in some Portland neighborhoods (see *MWN*, January/February 1982); he confirmed this conclusion in a June 1983 revised report. Peer reviews of both reports found that the author's data did not substantiate his conclusion. The other study, published in the March/April 1982 issue of the *Archives of Environmental Health* by Swedish researchers, found a higher than expected incidence of fetal deaths and malformed infants among physiotherapists who used shortwave diathermy equipment (see *MWN*, June 1982).

Elder also raised the issues of whole body versus localized SARs, potential psychological effects of RF hearing and extrapolation from animals to humans. The panel skipped over the first two items, though Professors Arthur Guy and Stephen Cleary argued over the clinical significance of RF hearing. Problems with extrapolation received considerable attention. ORD was criticized for its assumption, listed in the report's introduction, that humans and other mammals are equally sensitive to RF radiation.

Revision Schedule

Professor Charles Susskind, panel chairman, skillfully kept the meeting on track and on schedule. But in the push to complete final business, the panel had no time to discuss seven questions submitted by ORP's Janes. These are reprinted below.

Susskind requested that EPA's revisions for those sections of the report requiring only minor changes be sent to panel members by October 15 and returned to Elder by October 31. Sections requiring major rewrites should reach the members by November 15 and be returned by November 30. By handling the revision process through the mail, Susskind hopes that only a few panel members will have to meet in December for the final review. Susskind plans to submit a written report on the panel's initial findings to the SAB executive board when it meets October 13-14.

Minutes for the meeting will be available from Dr. Douglas Seba, SAB Executive Secretary, EPA Headquarters, 401 M Street, SW, Washington, DC, (202) 382-2552. A transcript of the entire proceedings is available for $0.40 per page from the Executive Court Reporters, 8525 Colesville Road, Silver Spring, MD 20910, (301) 565-0054. The transcript is approximately 300 pages.

Copies of ORD's draft report, *Biological Effects of Radiofrequency Radiation*, No. EPA-600/8-83-026A are now available from David Janes at the Office of Radiation Programs, EPA Headquarters, (703) 557-8217.

SAB Panel Membership

Dr. Eleanor Adair, John Pierce Foundation, New Haven; Dr. Barbara Chang, Medical College of Georgia, Augusta; Dr. Stephen Cleary, Virginia Commonwealth University, Richmond; Dr. Carl Durney, University of Utah, Salt Lake City; Dr. Arthur Guy, University of Washington, Seattle; Dr. Steven Horvath, University of California, Santa Barbara; Dr. Abraham Lilienfeld, Johns Hopkins University, Baltimore (unable to attend meeting); Dr. Sol Michaelson, University of Rochester; Dr. Mary Ellen O'Connor, University of Tulsa; Dr. Charlotte Silverman, FDA National Center for Devices and Radiological Health, Rockville; Dr. Charles Susskind (Chairman), University of California, Berkeley. Dr. Douglas Seba, SAB Executive Sectretary, EPA, Washington.

Questions on RF/MW Draft Report from ORP's David Janes

1. Should data on perception and shock phenomena be considered in addition to SAR-related effects, particularly at lower frequencies? If yes, is it appropriate for this subject to be addressed in this document or in another independent report?

2. Is the available data adequate to address the effects of pulsed fields, including the hearing phenomenon? Is this topic sufficiently treated in the document? Is the scientific data base sufficiently evolved to permit development of environmental exposure guidance for pulsed fields?

3. Is the available data adequate to address the consequences of time-averaging of SAR-related biological effects? Is this topic sufficiently treated in the document? Is the scientific data base sufficiently evolved to permit development of environmental exposure guidance which includes concepts of time-averaging?

4. Is there enough information currently available to consider the clinical or public health significance of observed biological effects as reported in the document?

5. The onset of thermoregulatory response appears to be a threshold phenomenon. Does the report properly project the SAR for the onset of thermoregulatory responses in humans? If not, what is a better estimate? Are there data, either in the document or elsewhere, that argue for the occurrence of adverse effects at levels below those that trigger thermoregulatory responses?

6. To what extent can SAR-related biological effects be projected to define effects at frequencies other than the frequency of study? (Please address extrapolation to frequencies both within and beyond the range of coverage of the document.) If yes, what are the exceptions, if any?

7. Do recent refinements in models, i.e., actual human shapes, cause significant deviations from predictions of SARs based on the spheroidal models used in the document? If yes, should they be treated in the document?

Excerpts from Comments on EPA's External Review Draft Report on RF/MW Bioeffects

The extracts below are taken from six sets of comments on EPA's external review draft of its report Biological Effects of Radiofrequency Radiation, *submitted prior to the September 22-23 meeting of SAB's special review panel. EPA's Environmental Criteria and Assessment Office in Research Triangle Park, NC, received comments from Warren Gleseking for AT&T, John Bergeron for General Electric, Daniel Bart for GTE, Kenneth Cox for MCI and John Osepchuk for Raytheon. John Mitchell of the Air Force School of Aerospace Medicine submitted his comments to the agency's Scientific Advisory Board.*

Air Force: Any extrapolation from animal data to the human condition should be based on all available data of comparable validity. There are major scientific flaws in mixing different thermoregulatory responses in different species, measured in different ambient conditions and comparing actual data with predictive data from models. Our analysis of some relevant data shows that the extrapolation provided in this document is probably not correct. Ideally, data for a single thermoregulatory response in a single species over a wide range of masses at constant ambient conditions should be used to establish a relationship of threshold SAR to body mass.

AT&T: It is our opinion that this critical and comprehensive review of the available literature on the subject is a thorough and competent effort, and should be a good basis for the EPA to arrive at reasonable and effective environmental exposure standards or recommendations.

General Electric: Although localized internal energy deposition can occur in specific experimental exposures, in real life three factors tend to nullify any such effect: The first is that most exposures will be non-resonant, the second is that normal motion and posture changes will produce fluctuations in the location and intensity of energy deposition, and the third is that real-life environmental exposures entail such low SARs that localized "hot spots" are very unlikely given thermal diffusion and blood circulation. Given these factors, the fear of "hot spots" in real-life exposures seems greatly exaggerated....If EPA were to accept for policy purposes the inappropriate species extrapolations and untested model that underlie [an estimated response threshold that occasionally may be lower than 0.4 W/Kg], the limit obtained would not only be tenuously founded but also would reflect a "no-effect" goal rather than a "no-harm" goal....What is novel in the draft document is the use of resting metabolic rate to scale the relative importance of a given SAR between species, a device that makes it appear initially that man is 6.4-fold more susceptible than the mouse to a given small SAR. It is not incorrect to say that an SAR of 1 W/Kg is proportionately greater with respect to the resting metabolic rate in man than in the mouse, but it is misleading and inappropriate to imply thereby that man is correspondingly at greater risk....Because of the great differences in mechanisms and capacity to thermoregulate between rodents and man, even valid comparisons for a given facet of thermoregulation would be inappropriate guides if taken out of the context of overall thermoregulation.

GTE: The final report should include a summary of known or deduced energy windows or thresholds, along with considerations that suggest the highest permissible peak levels for short exposure....Pertinent to establishment of a standard is an understanding of the variations in power density likely to occur in the far field owing to terrain irregularities and structures. For compliance purposes, suggestions should be included on spatial averaging as a means of establishing a representative power density.

MCI: MCI Communications commends the Environmental Protection Agency on its comprehensive review of the scientific information on the biological effects of radiofrequency (RF) radiation....MCI submits this filing not to comment on the technical accuracy of the report, with which MCI takes no issue, but for the purpose of urging the agency to move expeditiously to address the remaining task of establishing standards for safe exposure to radiofrequency energy....The absence of a generally accepted safe level of exposure for the population at large will continue to have a financial impact on the radio route construction plans of MCI and the other common carriers. An increase in the costs of developing, engineering and constructing radio routes is caused by the need to re-route segments of a radio route in order to overcome construction denials and withholding construction permits.

Raytheon: The review generally adheres to a critical standard of high scientific values and criteria. It emphasizes the hard scientific data, which is on a quantitative basis, with more discriminating attention to soft or speculative material....It is desirable that the frequency range of interest be extended down to 10 kHz from 0.5 MHz in order to include presently relevant public issues used as safety near navy VLF transmitters....The assumption of "equal sensitivity" for man and experimental animal is unwarranted. On the other hand, no account is made of the unique stress associated with the artificial constraints of a laboratory animal vs. the free human being....The general caveat on pulsed fields producing different effects than CW is of doubtful validity....It would appear from the recent literature that there is no substantiation for alleged BBB effects at flux densities less than 10 mW/cm^2.

HIGHLIGHTS

NMR: More than Spectroscopy and Imaging

Living systems can have unexpected biochemical and physical properties under conditions of nuclear magnetic resonance (NMR), according to recent experiments at the University of Salford in England. Although NMR spectroscopy has long been used to decipher molecular structure, and NMR imaging is winning a huge following as a diagnostic tool in medicine, this is the first indication that the biology of living organisms is affected by radiation at magnetic resonance frequencies.

The key finding of the Salford group, reported in a paper in the *Journal of Biological Physics*, is that "NMR can induce marked changes in the growth of biological cells." More generally, they found that biological materials are susceptible to specific frequencies, which are easily identified. The implications of the Salford experiments go far beyond the safety of NMR imagers because they show that the resonance frequencies associated with the earth's magnetic field can affect biological systems.

The location of resonance frequencies is a function of a nucleus' magnetic moment and the strength of the applied magnetic field. For example, a hydrogen atom (a proton) in a magnetic field of 400 gauss has a resonance frequency of 1.7 MHz. Thus a FONAR QED-80 imaging system with a 400 gauss permanent magnet uses an RF signal of 1.7 MHz (see p.10). In the earth's magnetic field of 0.5 gauss, the proton resonance frequency is 2.13 kHz.

Each nucleus with a magnetic moment will have its own set of resonance frequencies. Though not all isotopes have nuclear magnetic moments, many do, including carbon-13, nitrogen-14, oxygen-17 and chlorine-35.

Professor Cyril Smith and co-workers at Salford University found that in the earth's ambient magnetic field there were sharp resonances in the dielectric loss of live yeast cells at the NMR frequencies associated with hydrogen-1, sodium-23, phosphorus-31, chlorine-37 and potassium-39.

They also exposed soil bacteria to proton NMR conditions (a magnetic field of 250 gauss with an RF field of 1.06 MHz) and measured their rate of growth. To their surprise, they found nearly a doubling in the growth rate. The researchers conclude that these "unexpected" results "suggest that proton NMR speeds up DNA replication in the cells, which in turn implies that the test cells are ready to divide at an earlier stage in the cell cycle than the control cells."

They close the paper with an intriguing suggestion: the nuclear magnetic resonances may explain some of the effects claimed to be associated with power lines because, in the earth's magnetic field, the resonance frequency of potassium-39 is only one percent away from the second harmonic of 50 Hz and that of chlorine-35 is near the third harmonic of 60 Hz.

"Dielectric Measurements on Live Biological Materials Under Magnetic Resonance Conditions" by A.H. Jafary-Asl, S.N. Solanki, E. Aarholt and C.W. Smith appears in *Journal of Biological Physics, 11*, 15-22, 1983. The Salford group promises to elaborate on their findings in a subsequent paper.

Last year two of the authors, Smith and Aarholt, put forward the hypothesis that 50-60 Hz fields could promote the production of opiates in the human body (see *MWN*, April 1983). Their address is: Department of Electronic and Electrical Engineering, University of Salford, Salford, M5 4WT, England.

RTCA To Study RFI Aboard Aircraft

The Radio Technical Commission for Aeronautics (RTCA) has set up a special committee to study the potential for radiofrequency interference (RFI) from electronic and electrical equipment used aboard aircraft. The action came in response to growing concerns that radiation leaking from portable computers and similar devices could affect a plane's navigation and communication systems.

RTCA's Bill Fuchs told *Microwave News* that there are doubts this type of RFI is a problem, but that it is prudent to settle it one way or another.

The RTCA decision, reached at an Executive Committee meeting on September 23, was precipitated by a request from Eastern Airlines' D.W. Crosby, director of quality assurance and chief of engineering. Eastern asked RTCA to set industry-wide standards for use of electronic devices on aircraft. In his August 25 letter, Crosby cited an incident in which a hand-held Pac Man video game caused a jet engine to shut down.

Crosby also pointed to a number of press stories that questioned the safety of allowing passengers to use computers in flight. For instance, a widely circulated cover story in the August 22 *InfoWorld*, "Portable Computers: Hazards in the Air?" noted that Eastern Airlines had banned the use of computers by passengers on its jets as a precaution against RFI (see *MWN*, September 1983).

On September 22, the day before the RTCA Executive Committee meeting, the *Wall Street Journal* reported that American, United, Western and Continental Airlines had issued prohibitions similar to Eastern's. The article also cited an RFI incident aboard a United jet; a portable computer appeared to cause faulty readings in the plane's navigation equipment. Undeterred, Pan Am, Republic and TWA continue to allow their customers to compute in flight. The editorial writers at the *Journal* took a dim view of the ban in the next day's editions, calling it a dangerous case of over-regulation.

RTCA's Special Committee 156 will be chaired by Frank C. White, a technical advisor to RTCA and former staffer at the Air Transport Association of America. The committee's first meeting is scheduled for December 1-2.

The committee will offer recommendations on ways of controlling RFI in aircraft and on possible performance standards, which RTCA will use to revise its report *Interference to Aircraft Electronic Equipment from Devices Carried Aboard*, No. DO-119, issued April 12, 1963.

RTCA is a non-profit association of government and

non-government organizations, based in Washington, DC, with an interest in promoting aviation safety.

GTE Sprint Sues Over Local Microwave Law

GTE Sprint Communications Corp. has gone to court in an attempt to overturn a microwave transmission law enacted by the town of Pompey, NY, where the company operates a point-to-point relay facility. The law, which is intended to protect public health, would prevent GTE Sprint from expanding its operating capacity at the Pompey site.

Local Law No. 2 of 1982, passed by the Pompey Town Board on December 12, 1982, prohibits new commercial broadcasting facilities and requires a town permit for modifications of existing facilities. *A Law Regulating the Emission of Non-Ionizing Electromagnetic Radiation Within the Town of Pompey* also imposes a $100 annual fee on all commercial operators.

The US District Court for Northern New York issued a preliminary injunction August 30 blocking enforcement of the law. The town agreed to GTE Sprint's request for the injunction.

In its brief to the court, GTE argues that the Federal Communications Commission's (FCC) jurisdiction over microwave transmissions supersedes local laws, making the Pompey law unconstitutional. In any event, the company claims it is exempt from the law under an agreement with the town signed before the law was enacted.

Anthony Rivizzigno, attorney for Pompey, told *Microwave News* that the town's response to the suit was due in court October 3 but refused to comment further on the case.

GTE Sprint is concerned that enforcement of the law would establish a precedent permitting local jurisdictions to regulate the siting and operation of microwave transmitters. According to Bob Sills, an attorney with the New York City firm of Reboul, MacMurray which is representing GTE, this case is the first instance in which GTE Sprint has filed suit for the right to operate as it chooses on an existing site. The company previously has contested zoning challenges, he said.

Citing potential serious health hazards associated with non-ionizing electromagnetic radiation (NEMR), the Pompey law states that, "it is considered appropriate to restrict the increase of NEMR emission facilities." Pompey is located in an area of high ground in New York's Onondaga County which is the site of several microwave transmission facilities. Elsewhere in the county, as well as across the nation, sitings of microwave facilities have created controversies (see *MWN*, October and December 1982).

GTE Sprint's facility began operation in 1970 and is used by the company as a link between its midwestern and eastern telecommunications networks. Sills said that the facility was operating "at capacity" and that it is neither financially nor technically feasible to detour microwave transmissions around Pompey. GTE Sprint will suffer significant commercial losses due to insufficient transmission capacity if the town law prevents it from expanding the Pompey facility, the attorney said.

Local Law No. 2 was the outcome of a two-year effort by the Pompey Town Board to limit microwave transmissions. A moratorium on construction of commercial broadcast facilities was enacted October 13, 1980 and extended twice.

During the moratorium period, GTE Sprint negotiated an agreement with the town that it says exempted it from future laws as well as existing ones. In return, the company agreed to dismantle the smaller of two towers operating at its Pompey facility, which it did by June 30, 1983.

Six months after the agreement, on December 12, 1982, the Town Board passed Local Law No. 2, which required all commercial broadcasters to file a statement within 90 days providing technical data on operating broadcasting facilities. Also required is the annual fee of $100 "for the use by the town to conduct tests and studies concerning the emission levels and effects of NEMR and to monitor the levels of NEMR at various sites throughout the town." Sills says that GTE Sprint did not file a statement or pay the fee because it believed the prior agreement excluded it from having to do so.

On August 15, 1983, the town ordered GTE Sprint to comply with the law no later than September 1. The company then filed suit.

US Union Wins Alternative Work for Pregnant VDT Users

A Boston clerical workers' union has won the right for VDT operators to be assigned to non-VDT work during pregnancy in a contract agreement reached with Boston University (BU). This is the first major union contract in the US that allows VDT users to request alternative work for health and safety reasons. Union members ratified the agreement August 3.

Jenny Hochstadt, Health and Safety Officer for the United Auto Workers District 65 local at BU, told *Microwave News* that the contract, "provides very concrete improvements in working conditions at the university." The agreement does not acknowledge health risks associated with VDT use, however, stating that, "research to date has not proven that VDTs are a health and safety hazard."

The contract says that, "the university will attempt to reassign a pregnant employee to work which does not require the use of a VDT," at the employee's request. If alternative work is not "practicable" the employee will be eligible for up to three months of unpaid leave in addition to six months unpaid leave already provided for maternity.

Several Canadian unions have won the right for workers to be assigned alternative work. The Communication Workers of Canada was the first when Bell Canada agreed more than 2 years ago to allow pregnant operators to switch jobs or take extended maternity leave (see *MWN*, April 1981). Other major Canadian unions subsequently negotiated similar agreements including the Ontario Public Service Employees Union (see *MWN*, September 1982).

The contract also requires that BU make "every reasonable effort to ensure that workstation designs are appropriate for VDT use," reflecting the concern of many operators about musculo-skeletal and minor visual health effects. The university will prepare and distribute to all departments advisory guidelines explaining "appropriate installation and utilization" of VDT equipment. Hochstadt said that the 825-member union will be involved in preparation of the guidelines.

VDT health and safety became "the major issue" of the union's Health and Safety Committee a year ago, Hochstadt said, when four women operators had problem pregnancies (see *MWN*, October, 1982). In the past year another VDT user at the university has had a difficult pregnancy.

Hochstadt said that the new contract language grew out of the university's refusal to reassign a pregnant operator last fall. BU later reversed its decision following complaints from the woman's co-workers, making this a union issue. She said that six women at the university now have requested and been assigned to non-VDT work, all prior to the recent contract agreement. These reassignments set a precedent that Hochstadt said will discourage the university from urging maternity leave rather than providing alternative work.

BEMS '83: Part II

In our July/August issue we surveyed a number of reports from the annual meeting of the Bioelectromagnetics Society (BEMS) which dramatized the importance of the time variable in bioeffect studies. Outlined below are some of the other papers that were presented in Boulder, CO, the week of June 12th.

ELF

• A new type of effect on DNA from extremely low frequency (ELF) radiation exposures was reported by Dr. Abraham Liboff, a visiting scientist at the Naval Medical Research Institute in Bethesda, MD. Liboff used a wide range of frequencies between 10 Hz and 4 kHz and found that magnetic fields at intensities of 0.2-4.0 gauss, on the order of the earth's magnetic field, significantly increased DNA synthesis in human embryonic cells. The enhancement reached a maximum some 20 hours after the start of exposure during the mid-S phase of the cell cycle. Liboff has confirmed the effect with 13 different cell types. While he has been unable to find a consistent trend in the results, Liboff said that the effect was not dependent on heating, induced current (that is, changes in the magnetic field [dB/dt]) or frequency. Liboff plans to continue his experiments when he returns to Oakland University in Rochester, MI, in early October.

• Professor Hans-Arne Hansson of the Institute of Neurobiology at the University of Gothenburg, Sweden, disclosed new details on the "lamellar" bodies induced in Purkinje nerve cells of newborn rabbits by chronic exposure to 50 Hz radiation at an intensity of 14 kV/m (see *Brain Research, 216*, 187, 1981). Though he could not explain the cause or significance of the lamellar bodies, Hansson said that the effect appears to be species-dependent. He found the same kind of structures in pigs (30 kV/m at 60 Hz) as in rabbits but *not* in rats (14 kV/m at 50 and 60 Hz). The effect was only observed when the exposed animals were housed outdoors, not indoors, leading him to speculate that climatic and stress factors could be important variables.

• Dr. Hana Pafkova of the Institute of Hygiene and Epidemiology in Prague, Czechoslovakia, was unable to present her paper on the effect of electrostatic and 50 Hz fields on chicken embryos; Dr. Don Justesen of the VA Medical Center in Kansas City, MO, read it for her. Pafkova found "no important embryotropic effect" of a 50 Hz field, but did detect a significant retardation in development after repeated exposures (4-6 hours a day for a week) to a 17 kV/m pulsed electrostatic field. Acute exposures to a pulsed electrostatic field had no effect.

• Dr. Carl Blackman and co-workers at EPA's Health Effects Research Lab in Research Triangle Park, NC, have extended their studies on calcium efflux in chick brain tissue (see *MWN*, July/August 1982 and January/February 1983). Since last year's BEMS meeting, Blackman has experimented with frequencies as high as 120 Hz, using multiples of 15 Hz. Blackman reported finding highly significant results at odd multiples of 15 Hz, but that 60 and 90 Hz fields also showed significant efflux as compared to sham exposed animals. Signals at 120 Hz were not effective. Blackman advised that those planning large scale animal experiments should consider those frequency and intensity combinations that are biologically active.

• In an interview at the BEMS meeting, Dr. Jose M.R. Delgado of the Centro Ramon y Cajal in Madrid, Spain, said that he was preparing a new paper, to be published in the *Journal of Anatomy*, discussing the influence of pulse shape on the effects of low level, ELF magnetic fields on chick embryo development (see *MWN*, March 1983). He also said that his group was beginning work on an epidemiological study of workers exposed to 50 Hz radiation.

RF/MW Radiation

• Members of Professor A.W. Guy's lab at the University of Washington, Seattle, gave an advance report on the outcome of their long-term, low level study. Rats were exposed to 2450 MHz, 8 Hz modulated pulsed microwaves (10 us, 800 pps) for 25 months at a power density of 480 uW/cm^2, with an SAR of about 0.4 W/Kg. The data are now being analyzed; a final report should go to the project sponsor, the air force, by this fall. While a significant enhancement of B and T cells was observed in the interim kill, Dr. Lawrence Kunz reported that there was no change in these cells at the end of the experiment. Dr. Robert Johnson said that the exposed rats had a reduced food intake during the last 20 weeks of the experiment, showed variations in their corticosterone levels (no consistent trend was apparent) and had increased adrenal masses. There was no overall difference in death rate compared to controls. Kunz added that the animals were able to perceive a microwave environment but

that "there is no indication that this change in perception has any effect on the biology of the animal." They conclude: "Although final integration and interpretation of all data are still in progress, it is clear that while various end points show significant changes following exposure to pulsed RF [radiation], they appear to be of minor clinical significance with regard to overall mortality of the exposed population compared to sham exposed populations."

• Dr. Przemyslaw Czerski offered new data on his continuing studies on the mutagenic potential of microwaves. He said that he and Drs. Ewa Manikowska-Czerska and William Leach at FDA's National Center for Devices and Radiological Health in Rockville, MD, had demonstrated changes in chromosomes of male mice during spermatogenesis at 0.915, 2.45 and 9.45 GHz with SARs of 1 and 20 W/Kg. He warned that these results should be interpreted with caution because the effect was a function of dose rate, frequency, pulsing characteristics, method of exposure and sampling procedure. For instance, he explained that other experiments at 27 MHz at SARs of 1 and 3 W/Kg showed no mutagenic effect. He said that more research is needed to see whether the effect is reversible and to determine its biological significance.

• FDA's Dr. John Monahan presented some data on his experiments which are part of the US-USSR identical experiment (see *MWN*, July/August 1982). Researchers in each country are exposing male rats to 2450 MHz radiation at a power level of 10 mW/cm^2 for 7 hours. He reported that exposed rats displayed "altered behavior," but that it was not clear whether the effect reflected "changes in activity levels, altered emotionality, changes in memory or some other behavioral parameter."

Millimeter Waves

• A group led by Dr. Friedrich Kremer from the Max Planck Institute for Solid State Physics in Stuttgart, West Germany, reported that they had discovered a "significant" nonthermal effect of millimeter waves at a power level of less than 5 mW/cm^2 in the 64-69 GHz frequency range. Their experiment, which was run double blind, showed an impairment of the puffing pattern of giant chromosomes of a midge. They hypothesize that the observed effect could be understood in terms of Frohlich's theory of coherent excitations. (This paper has already been published in *Coherent Excitations in Biological Systems*, edited by H. Frohlich and F. Kremer, New York: Springer-Verlag, 1983.)

• US scientists have been unable to find any response to millimeter wave radiation. Professor Shirley Motzkin and co-workers at the Polytechnic Institute of New York in Brooklyn exposed E. coli to 45.5-46.1 GHz (6.5-6.59 mm) radiation at power levels of 0.05, 0.5 and 5 mW/cm^2, looking for enhanced colicin production as had been reported by Soviet researchers. They found no effect. Similarly, L. Furia, Dr. O. Gandhi and Dr. D.W. Hill of the University of Utah in Salt Lake City were unable to observe any change in the growth rate of yeast exposed to 41.82 and 41.84 GHz waves at a power density of 20 mW/cm^2 in the waveguide. (See also Bioeffects Update on p.9.)

Spectrum Static: Radio & TV RFI

The increasingly crowded radio spectrum is generating more and more complaints of radiofrequency interference (RFI) among users who share frequencies or whose allocations are next to each other. Three RFI cases now pending before the Federal Communications Commission (FCC) illustrate the commission's difficulties in finding equitable solutions which are politically viable. Indeed, the problem may get worse before it gets better.

UHF-Land Mobile

An FCC-backed plan to resolve interference between an Atlanta UHF-TV station and nearby land mobile services is losing momentum. In a June 23 letter the FCC instructed WVEU, Channel 69, to arrange and pay for the frequency relocation of 23 land mobile licensees and ordered the land mobile licensees to cooperate with WVEU. More than three months later little progress has been made.

The problem began in 1981 when WVEU began full power (2,630 kW) testing of its transmitter atop Atlanta's Peachtree Plaza Hotel, also the site of the land mobile repeaters (see *MWN*, December 1982). The proximity of the WVEU signal, at 800-806 MHz, to the land mobile facilities operating at 806-807 MHz produced out-of-band interference that persisted at much lower power levels. The station was ordered to cut power to 2.63 kW, a 30dB or a 1000-fold reduction.

When the FCC rejected WVEU's subsequent petition for half-power operation, the station proposed paying for changing the frequency of the land mobile licensees rather than its own frequency, which it estimated would cost 10 times more. The station says that relocation will not impair the operation of the land mobile repeaters.

The FCC gave WVEU 30 days from June 23 in which to submit a report regarding the "final decision of the affected parties," but an FCC spokesperson told *Microwave News* at the end of September that no report has yet been provided. WVEU officials could not be reached for comment but one indication that things have turned sour is that three land mobile licensees have filed petitions asking the commission to reconsider its support for the WVEU relocation plan.

Cable TV-Amateur Radio Conflict

The American Radio Relay League (ARRL) has renewed its request that the FCC prohibit cable TV from broadcasting on amateur radio frequencies. The National Cable Television Association (NCTA) objected to the League's action in formal comments submitted to the commission. Previously NCTA had called the ARRL plan a "draconian proposal."

Citing the "burgeoning cable TV signal leakage interference problem," ARRL asked the FCC to expedite consideration of its January 1982 petition seeking the frequency exclusion. ARRL contends that NCTA has failed to follow through on joint attempts to resolve interference problems. After the original September 15, 1982 FCC deadline for filing comments on the ARRL plan, NCTA "ceased all

efforts to work with the league to resolve interference problems," according to ARRL. The league says that more than 100 cases of cable-amateur radio interference remain unresolved and that "the problem is as acute as, or worse than" it was when the original petition was filed.

Wendell Bailey, Vice President for Science and Technology for NCTA, told *Microwave News* that ARRL is unrealistic in demanding a clear radiofrequency environment. NCTA says that cable-amateur interference is a "two way street" and that cable broadcasters experience interference from amateur radio transmissions. Bailey said that NCTA had worked with ARRL to resolve 42 cases of RFI and that the issue is a "high priority with NCTA."

The cable association asked the FCC to deny ARRL's request to expedite proceedings and also urged that the January 1982 petition be dismissed. An FCC staffer said that the ARRL petition is pending and that no date for commission action has been set.

TV6-FM Interference

Responses to a proposed FCC rule intended to minimize FM radio interference with channel 6 TV (47 *Federal Register* 24144, June 3, 1982) indicate sharp differences between commercial TV and non-commercial FM broadcasters. The FCC's final decision in this case could greatly affect how the broadcasters do business in the future.

National Public Radio (NPR) and the Corporation for Public Broadcasting (CPB) contend that the "long-term solution" lies in improved TV receiver selectivity. The National Association of Broadcasters (NAB), the Association of Maximum Service Telecasters (AMST) and other commercial broadcast organizations argue for restrictions on FM spectrum allocation and other measures that place the burden on FM stations operating between 88 and 92 MHz, a range allocated to non-commercial educational assignments (for a review of the comments to the FCC, see the September 12 *Broadcasting*).

An FCC spokesperson called this a "no-win situation, a hopeless case." Whichever way it is resolved, he said, one side will be greatly inconvenienced. Review of the comments received will begin in early November and a report is likely by May of next year, he said.

The upper limit of Channel 6 transmissions, at 88 MHz, abuts the noncommercial FM radio frequencies. TV signals are susceptible in large part because they are transmitted over a wide band whereas FM uses smaller bands.

Prior efforts by radio and TV broadcasters to resolve this RFI problem have failed and the debate on the basic issue of who will make the necessary changes remains polarized.

CONFERENCES

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, (202) 488-6328.

November 7-9: ***Non-Linear Electromagnetic Interactions with Tissue,*** University of Maryland, College Park, MD. Contact: Professor Leonard Taylor, Dept. of Electrical Engineering, University of Maryland, College Park, MD 20742, (301) 454-6850.

November 7-9: ***1983 Satellite Communications Symposium,*** Hyatt Regency Hotel, Atlanta, GA. Contact: Betsy Crawley, Symposium Coordinator, 3845 Pleasantdale Rd., Atlanta, GA 30340. (404) 577-1234.

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, (412) 256-3556.

November 13-18: ***69th Annual Meeting of the Radiological Society of North America,*** McCormick Place, Chicago, IL. Contact: George Schyler, RSNA, 1415 W. 22nd St., Suite 11509, Oak Brook, IL 60521, (312) 920-2670.

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, (202) 682-0266.

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. (93) 41-17-17.

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, (212) 673-4700.

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, (617) 253-5561.

1984

January 11-14: ***National Radio Science Meeting,*** University of Colorado, Boulder. Contact: S.W. Maley, Dept. of Electrical Engineering, University of Colorado, Boulder, CO, 80309, (303) 492-7004.

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, (913) 864-4836.

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, (213) 475-4571.

January 27-29: ***Symposium on NMR Imaging,*** Fontainebleau Hotel, Miami Beach, FL. Contact: American College of Radiology, 6900 Wisconsin Ave., Chevy Chase, MD 20815, (301) 654-6900.

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, (301) 496-5133.

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, (703) 558-3617.

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 (404) 424-9621.