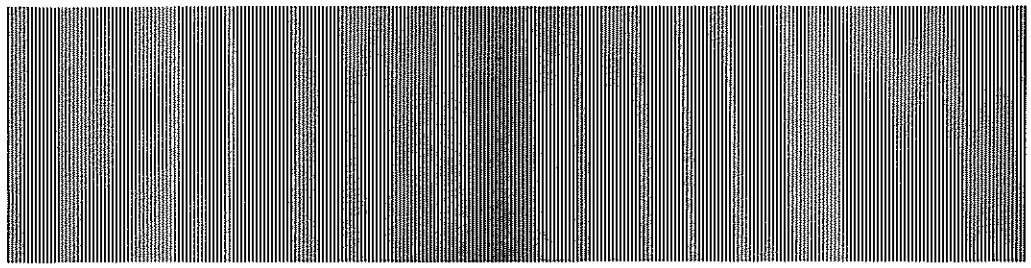


MICRO WAVE NEWS



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A Monthly Report on Non-Ionizing Radiation

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ANSI Exploring RFI Standards for Home Electronic Equipment

The American National Standards Institute (ANSI) has set up a task group to explore ways of meeting a congressional mandate to reduce radiofrequency interference (RFI) to home electronic equipment. The group, working under the chairmanship of American Bell's Don Heirman, will suggest methods of enhancing the immunity of television sets, radios and personal computers from spurious radiation.

Members of ANSI's C63 Committee on Radio-Electrical Coordination decided to form the ad hoc panel at an April 6 meeting in Washington, DC, after the Federal Communications Commission's (FCC) Robert Ungar urged industry to design consumer products with greater immunity to RFI. "The FCC will act if no one else does," he said, "but we have neither the staff nor the resources to devote to this—and we certainly cannot do this in a short amount of time." Ungar is with the commission's Office of Science and Technology.

Congress authorized the FCC to set minimum performance RFI standards in the Communications Amendments Act of 1982 (see *MWN*, September and October 1982). The commission is not *required* to set standards, however—it can opt for alternatives like warning labels. Whatever the approach, Congress cautioned that it expects "the number of interference complaints recorded and investigated by the commission to be significantly reduced." (In fiscal year 1982, the FCC received over 60,000 complaints of RFI to home entertainment equipment.)

In a telephone interview from his office in Holmdel, NJ, Heirman said that he has asked the task group to assemble in Washington during the week of May 9. He plans to discuss FCC needs at the June 23 meeting of the Institute of Electrical and Electronics Engineers' (IEEE) Standards Board. In addition to Heirman, the members of the group are Harold Gauper of General Electric, Eb Tingley of the Electronics Industries Association's Consumer Electronics Group and FCC's Daniel Yates.

The ANSI C63 committee has also invited a representative from the American Radio Relay League (ARRL) to join the task group. Perry Williams, ARRL's Washington area coordinator, said that Hugh Turnbull would participate. Turnbull is the chairman of the league's RFI task group. Both Williams and Turnbull said they were "delighted" by the ANSI initiative and are prepared to accept a "meaningful" voluntary approach because it would be quicker than a government solution. ARRL lobbied for the RFI provisions when the amendments were still in congressional committee.

Professor Ralph Showers of the University of Pennsylvania, the chairman of the

(continued on p. 8)

To Our Readers

Microwave News is expanding to 12 pages. Beginning with the July/August issue, all our reports will be printed in larger type to make reading easier. In addition to providing more room for news, the new format will enable us to add a small classified ad section. For information on placing a notice in *Microwave News*, please call us at (212) 794-9633.

HIGHLIGHTS

Three States Hold Hearings on VDTs

Video display terminal (VDT) workers, owners and manufacturers gathered at hearings in three states last month to discuss proposed safety regulations. Although the VDT measures are hotly debated, with labor pro and business con, legislative committees in Massachusetts, New York and Oregon appear to favor some type of action.

In Massachusetts, the Committee on Commerce and Labor recommended passage of House Study Bill No. 2267 after an April 20 hearing. If the measure is approved, a group will be set up this summer to investigate VDT safety issues. A second house bill (No. 2658) containing specific rules for VDT use and work place design is in abeyance.

New York's April 14 hearing left Assemblyman Frank Barbaro convinced that VDT legislation is needed and he plans to introduce a bill in early May. (At Barbaro's invitation, the Assembly Labor Committee will hear a VDT presentation from the New York Committee for Occupational Safety and Health on May 10.) Meanwhile, the NY Senate Labor Committee has decided not to consider a bill proposed by Senator Joseph Montalto: Senate Bill No. 4314 would have required employers to furnish "a radiation protection jacket or blanket" to pregnant VDT operators upon request.

Oregon's Senate Labor Committee has yet to act on Bill No. 568. Members heard from 40 witnesses at a seven-hour hearing on April 25. Observers say the committee is sympathetic to worker and union requests for legislation and anticipate that the bill, with slight modification, will go to the senate.

For a brief review of these bills and proposals in several other states, see our April issue. ☛

Air Force and Navy To Fund Study of VLF Hazards

The air force and navy will soon sponsor a joint study of hazards associated with exposures to very low frequency (VLF) radiation (10 kHz to 3 MHz). Four bids were received in response to a November request for proposals, and, according to William Hurt at the Air Force School of Aerospace Medicine in San Antonio, TX, an award will be announced in June or July.

One of the project's main objectives is to recommend "realistic" occupational and general population safety standards for VLF radiation. These will be defined either by conditions that produce induced currents resulting in perception, shock, fibrillation or burns, or a 0.4 W/Kg whole-body specific absorption rate (SAR) or 8 W/Kg local SAR in any one gram of tissue, whichever is the most restrictive.

The research project does not include any experimental studies of the biological effects of VLF radiation. The contractor will estimate induced body currents and calculate SARs produced by electric fields as a function of frequency, as well as measure radiation levels at specific sites near sources operating at 20, 50, and 100 kHz as well as 3 MHz.

This effort is a continuation of three preliminary studies (*VLF Hazards Analysis*) funded by the air force and completed last summer by (1) O.P. Gandhi and I. Chatterjee at the University of Utah, Salt Lake City; (2) A.W. Guy and C.K. Chou at the University of Washington, Seattle; and (3) D.J. Schaefer, W.B. Warren and F.L. Cain at the Georgia Institute of Technology in Atlanta. All three found the existing data base on the bioeffects of VLF radiation to be very limited. As Guy and Chou note, "The current status of research is very similar to that of microwave

research in the early 1960s." They found that the majority of the available studies are from the Soviet Union.

The three reports are not readily available. Those interested in obtaining copies should contact William Hurt, AF School of Aerospace Medicine, Brooks AFB, TX 78235, (512) 536-3749. The Utah group published some of their results in the December 1982 issue of the *Proceedings of the IEEE*. ☛

ANSI C63: Progress on EMC Standards

Members of the American National Standards Institute's (ANSI) C63 committee assembled in Washington, DC, on April 6 to consider a wide range of pending electromagnetic compatibility (EMC) issues (see *MWN*, December 1982). The one major item of new business was the formation of a special task group to consider ways of improving the immunity of home electronic equipment from radio frequency interference (RFI) - (see story on p.1).

The chairman of C63, Professor Ralph Showers of the University of Pennsylvania, announced that he plans to hold a vote on the revised ANSI C63.4 standard, which includes "Open Area Test Sites" (OATS), by August. Don Heirman of American Bell (Holmdel, NJ) circulated the tenth draft of the OATS document, which he has now integrated into the body of the C63.4 standard on methods of measuring radio noise emissions (10 kHz-1 GHz). All subcommittee 1 comments on the draft are due by June 1.

In an update on the activities of the International Special Committee on Radio Interference (CISPR), Herbert Mertel of EMACO (San Diego, CA) said that there is intense interest in Europe—especially in the Scandinavian countries—on the development of immunity standards for electronic products. This has resulted in numerous requests for draft standards and documents. The committee decided that only abstracts of working papers would be made available and that Mertel will act as the contact for foreign inquiries. Mertel also announced that CISPR subcommittee A will soon issue a document on test sites.

Wallace Amos of Burroughs Corp. (Paoli, PA) reported that subcommittee B failed to agree on a standard for data processing equipment. He said that he believes emission limits will have to be lower than those adopted by the Federal Communications Commission (FCC) if an international consensus is to be reached. Because no subcommittee B meetings are planned before 1984, he added, new standards could not be adopted before 1985.

FCC's Art Wall explained that there is a growing difficulty in distinguishing between the equipment addressed by CISPR's subcommittees B and F (B is on industrial, scientific and medical equipment, and F is on motors, household appliances and lighting apparatus). He cited computers as an example: they fit into both groups. New classification schemes could be based on power, or site of use (home vs. office). T. Lamont Wilson, a consultant based in Louisville, KY, will chair a task group to formulate a US position on the Band F problem.

Before the full committee met, members of ANSI C63's subcommittee 1 received the second draft of *Immunity Measurements: Procedures and Equipment for Electronic Products*, which was prepared by Heirman. The subcommittee voted unanimously to recommend that it be issued as a separate document instead of as additions to the C63.2 and C63.4 standards. "In that way all the immunity material will be in one place," explained Heirman. The proposal was passed on to the full C63 committee, which has yet to act on the proposal. Members of the immunity task force are expected to comment on the draft by June 1; Heirman would like to schedule a vote by late June and forward the document to the parent committee by September.

EMACO's Mertel detailed his progress in writing a national EMC standard. While there is still some question as to what will be included in the text and what will be incorporated by reference, he hopes to complete a first draft by August 1, and finish the document by next year.

Subcommittee 1 Chairman Edwin Bronaugh attempted, unsuccessfully, to recruit a chairman for a new task group to set limits on RF emissions and susceptibility of medical devices. Bronaugh, who is with Electro-Metrics (Amsterdam, NY), was able to set up two other task groups: Harold Gauper of GE (Schenectady, NY) will head a panel on the interpretation of quasi-peak measurements, and Marge Stone of AEL Industries (Farmingdale, NJ) volunteered to chair a group on extending C63.4 to automatic test equipment, including spectrum analyzers and automatic scanning receivers.

Richard Schulz of the IIT Research Institute (Annapolis, MD) announced the publication of two new handbooks he prepared for the Electromagnetic Compatibility Analysis Center (ECAC) under a contract from the Air Force Electronic Systems Division: *EMC Standards Manual, Revision 4*, (No. ECAC-HDBK-82-043) and *Radiation Hazards Manual, Revision 2*, (No. ECAC-HDBK-82-005). Both volumes are dated November 1982 and can be ordered from the National Technical Information Service (NTIS), Springfield, VA 22161. (Order numbers and prices were not available at press time.)

The next meeting of both the full C63 committee and subcommittee 1 will be on August 26, following the EMC Symposium (see Conference Calendar, p.8). ●

BSD's Hyperthermia Unit Nears Approval

The Food and Drug Administration's (FDA) Radiologic Devices Panel has found BSD Medical Corp.'s hyperthermia unit to be "approvable" for marketing subject to certain conditions. Dr. William Dirksen, BSD's director of research and regulatory affairs, said that he was "very pleased" with the FDA's decision and that the company is now negotiating with the agency on labelling language. The label will stipulate how the unit can be used in cancer treatment.

If BSD's hyperthermia system wins approval, it would become the first commercially available radiofrequency and microwave (RF/MW) heat treatment for cancer therapy in the United States. Two years ago, the FDA refused to okay the Magnetron unit developed at Henry Medical Electronics and the University of California Medical School in Los Angeles (see *MWN*, May 1981).

The BSD-1000 hyperthermia unit operates at any frequency between 50 and 1,000 MHz and can use a variety of local applicators, either singly or in combination, to heat tumors with RF/MW energy. It is designed to operate in a RF-isolated screen room.

Before the BSD unit can be marketed, it must still win a positive recommendation from the advisory panel as well as official approval from the FDA. The panel's most recent decision was reached over the telephone; final approval can only come at a formal meeting. FDA's Dr. Robert Phillips, the panel's executive secretary, expects a meeting will be held in early summer.

At a December 9 meeting, the radiology panel voted two to one against granting BSD's application for premarket approval pending more data on its efficacy. Specifically, the panel objected to the lack of statistical controls in the clinical data presented by BSD (see *MWN*, January/February 1983). Dirksen said that BSD submitted the necessary information to the panel, and that formed the basis for its revised opinion. BSD is based in Salt Lake City, UT. ●

Narda To Develop Radiation Hazard Meter for the Navy

The Naval Surface Weapons Center in Dahlgren, VA, has awarded Narda Microwave Corp. a \$200,000 contract to develop a meter for measuring radiation exposures in the 2 MHz to 40 GHz frequency range. The radiation hazard test set, designated AN/PSM-46, is part of the navy's Combat Readiness Electromagnetic Analysis Measurement (CREAM) program.

The meter will be keyed to the new American National Standards Institute (ANSI) C95.1-1982 safety standard, and will display radiation levels as a percentage of the maximum permissible exposure levels—independent of the number of incident signals, their frequency, direction, polarization or modulation characteristics.

Although the navy is still using a flat 10 mW/cm² exposure standard, the adoption of a new standard identical to ANSI's is under consideration. According to Lt. Roby Enge of the Naval Medical Command, the proposed revision is still in draft form and is now being reviewed by the navy's operational and medical commands.

Paulo Perini, a staffer with the CREAM program, points out that the lower frequency limit for the test set is 2 MHz, in contrast to 300 kHz for the ANSI standard, because there are no radiation sources below 2 MHz aboard navy ships.

The Narda contract was signed April 1 and runs nine months. The navy will then evaluate the test set and decide how to proceed. Narda is based in Hauppauge, NY.

Also in April, Loral Corp. of New York City bought Narda Microwave Corp. for approximately \$45 million in stock. Loral is a major producer of electronic warfare systems. ●

Over-the-Horizon Radar EIS

The air force has released a draft environmental impact statement (EIS) for the construction and operation of its west coast over-the-horizon backscatter (OTH-B) radar. The system, which operates in six frequency bands between 5 and 28 MHz, can detect aircraft flying at any altitude at a distance of 500 to 1,800 miles.

The air force is considering two sites in Oregon for the transmitting antenna; the location of the receiver will be in northern California. According to the EIS, the calculated average power densities at ground level outside an exclusion fence would not exceed 100 uW/cm² for any OTH-B frequency: "Predicted values of average power density at ground level are less than 2 uW/cm² for all inhabited areas in the general vicinity of the two candidate transmitters." The air force notes that the validity of its computation methods was confirmed by measurements made in June 1981 at the experimental OTH radar station in Maine. No impacts on pacemakers outside the exclusion fence are anticipated.

The air force anticipates there will be no radiofrequency interference (RFI) in high frequency amateur bands and maritime or aeronautical mobile bands. Land mobile radio will be affected within three or four miles of the transmitter, with some AM and

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FM interference within about two miles. There may be some RFI in international broadcast bands, but the air force cannot predict when or where. In addition, harmonics could interfere with very high frequency air-to-ground communications within a few miles and omnirange (VOR) receivers within 30 miles. In both these instances, however, the air force says mitigation measures could prevent unwanted RFI.

Comments on the EIS are due by June 10. For more information, contact Mr. Ro Raffa, Electronic Systems Command, Hanscom AFB, MA 01731, (617) 271-7976.

The air force is in the process of building a full-scale OTH-B in Maine on the site of the now dismantled experimental OTH radar system (see *MWN*, September 1982) and has begun planning a third, south-looking system. In addition, the Naval Electronic System Command is developing an OTH radar that can be moved by ship, aircraft or truck. ☛

Project ELF Radiation Survey

The IIT Research Institute (IITRI) staff has measured the electric and magnetic fields associated with the navy's Clam Lake ELF facility in Wisconsin. Radiation levels associated with both the Project ELF antennas at 76 Hz and low voltage power lines at 60 Hz were measured at more than 50 locations within a 25-mile radius of the navy facility. IITRI is based in Chicago, IL.

In general, the data show that magnetic and electric fields are higher near buildings than in open areas. The maximum 76 Hz magnetic field one mile from the ELF antennas was 1.4 milligauss in an inhabited location and 2.4 milligauss along a highway. At distances greater than ten miles from the facility, the maximum magnetic fields were 0.48 milligauss (inhabited) and 0.23 milligauss (uninhabited). There was little difference between the intensity of the magnetic fields measured inside and outside at each location.

For 76 Hz electric fields, the maximum recorded values in the soil near the Clam Lake station were 0.08 V/m (inhabited) and 0.03 V/m (uninhabited). In the air, the levels were 0.12 V/m (indoors, inhabited) and 0.16 (outdoors, inhabited) and 0.094 V/m (uninhabited). At more than 10 miles from the antennas, the maximum values in the soil were: 0.0013 V/m (inhabited) and 0.017 V/m (uninhabited); and in the air: 0.01 V/m (indoors, inhabited), 0.021 V/m (outdoors, inhabited) and 0.03 V/m (uninhabited).

In an analysis of the IITRI survey results, Dr. Nancy Wertheimer and Ed Leeper, who have linked weak levels of power line radiation with cancer, consider the 0.48 milligauss level to be "surprising" and suggest that the "fields are being dispersed by some means quite different from the usual field dispersal from power lines—perhaps by leakage of ELF currents into power lines and other conducting channels." They urge more study of these dispersal mechanisms. Wertheimer and Leeper's studies indicated that homes with an increased cancer risk had a median magnetic field of about 1 milligauss (see *MWN*, March 1983). ☛

Public RF/MW Exposure Limits Proposed in Oregon

Oregon State Senators Steve Starkovich and Tony Meeker have introduced legislation to limit public exposure to radiofrequency and microwave (RF/MW) radiation. Under the proposed law, the state would adopt the Multnomah County standard for 100 kHz to 300 GHz radiation, which at its strictest level (for the 30 to 300 MHz band) limits exposures to 200 $\mu\text{W}/\text{cm}^2$.

The Senate Energy and Environment Committee plans to hold a public hearing on the measure in early May. According to Starkovich's aide Jim Edmonds, "chances for the bill reaching the senate in its current form are slim." Edmonds said the hearing

would be valuable in itself as a state-wide forum for discussing radiation hazard issues.

Senate Bill 623 incorporates the exposure standards adopted in Multnomah County Ordinance 330. Modeled after Massachusetts' proposed standard, the county's 200 $\mu\text{W}/\text{cm}^2$ limit rises to 1 mW/cm^2 for frequencies above 1500 MHz and to 20 mW/cm^2 for those below 3 MHz. (See *MWN*, May, June and July/August 1982.) The Oregon law would not cover portable sources emitting 100 watts or less (ERP), any source emitting 7 watts or less, and industrial, scientific and medical equipment. A state-wide program would be set up to identify sources and measure radiation levels.

The bill was drafted at the request of People Against the Tower (PAT), a citizens' group seeking the removal of a large UHF TV tower in Silverton, OR. A PAT spokesman explained that some residents are pushing for a radiation exposure rule "as a matter of principle." The proposed standard would have no effect on Silverton, where estimated radiation exposures are no more than 1 $\mu\text{W}/\text{cm}^2$. ☛

Zurich EMC Symposium

More than 100 papers were presented to an audience of 510 at the 5th Electromagnetic Compatibility Symposium and Technical Exposition, held in Zurich, Switzerland, March 8-10. A review of the proceedings reveals the wide range of topics covered by the participants — everything from models to measurements and shielding to standards.

One of the most significant trends is the growing attention to electromagnetic pulse (EMP) radiation. Over a dozen papers, many from European researchers, addressed EMP interactions. One engineer said he was surprised to see such interest in what was once an overlooked type of nuclear weapon radiation.

Here are some highlights from the published papers:

- On the basis of satellite-generated very low frequency (VLF) radiation data, K. Bullough and A. Cotterill of the Dept. of Physics at the University of Sheffield, England, estimate that power line harmonic radiation "may be responsible for the secular increase, which varies from 5 to 25 percent, in thunderstorm occurrence over southern Canada in the period 1935 to 1970 relative to that in the period 1900 to 1935."

- Michel Sirel of the Societe Les Cables de Lyon in Paris offers a new view of EMP propagation below ground. His experimental work leads him to conclude that at a depth of 500 meters in granite soil, an EMP signal has a much greater amplitude than predicted by theory.

- A study of radiation risks in the amateur radio service by two Polish researchers concludes that, with a good transmitter and a properly installed antenna, amateur stations do not present a public hazard, even taking into account the strict Polish electromagnetic radiation standards.

- A.C.D. Whitehouse of the UK Home Office's Directorate of Radio Technology makes a strong case for international EMC standards. Two examples: When CB radios were imported into the UK, they caused severe RFI problems, especially to radio and TV receivers. The government later introduced its own CB equipment, with an FM modulation in contrast to the earlier AM modulated sets. But there were enough old CBs around to force the government to consider immunity standards. Also, conflicting regulations on electric lawn mowers vitiated EMC precautions. A safety standard required the mowers to have a cord of minimum length, but the cord produced resonant effects that invalidated the results of RFI testing.

- J.F. Fisher of Xerox in El Segundo, CA, describes a method of correlating surface currents with radiated fields for frequencies above 30 MHz as a way of avoiding costly open field radiation testing. Fisher used a current sensor to estimate emissions from

large and small copiers and from a word processor with very reasonable accuracy.

Those interested in obtaining a copy of the symposium proceedings should contact: T. Dvorak, EMC Proceedings Editor, ETH Zentrum —IKT, 8092 Zurich, Switzerland. ●

WHO Non-Ionizing Radiation Protection Report

The World Health Organization's (WHO) European Regional Office has published a report on the health effects of non-ionizing radiation. *Non-Ionizing Radiation Protection* is a 267-page compilation of papers that cover the spectrum from ultraviolet to ELF. Each chapter includes recommendations for avoiding hazardous exposures and is annotated with extensive references.

Radiofrequency (RF) and microwave (MW) radiation effects are reviewed by Professor Sol Michaelson of the University of Rochester, NY. Michaelson recommends efforts be made "to minimize the impact" of RF/MW sources in the environment, adding that "voluntary action in this direction may avoid the necessity for mandatory regulation." He notes that "information is available only for a limited range of [MW] frequencies and is lacking on the effects of repetitive and chronic exposure, and on the dose and frequency dependence of effects in biological systems."

For 50 and 60 Hz radiation, Professor R. Hauf of the Research Institute of Electropathology, Freiburg, West Germany, concludes that 20 kV/m electric fields and 240 A/m magnetic fields are safe, as are those produced by transmission systems operating at voltages of up to 420 kV. Although Hauf believes fields from systems with even higher voltages are not hazardous, he recommends that epidemiological studies "should be continued, especially on workers exposed to 800 kV systems..."

Other chapters examine ultraviolet, optical and infrared radiation, lasers, and ultrasound, as well as regulations and enforcement procedures.

Non-Ionizing Radiation Protection (WHO Regional Publications, European Series No. 10, 1982), edited by M.J. Suess, is available for \$15.75 including postage from the WHO Publications Center, 49 Sheridan Avenue, Albany, NY 12210, or from your nearest WHO distribution office.

URSI Symposium on Bioeffects of MM Waves

URSI's Working Group on Measurements Related to the Interaction of Electromagnetic Fields with Biological Systems is organizing a symposium on *Techniques in Studies of Biological Effects of Low-Level Millimeter Waves* to be held September 4-6 near Munich, West Germany.

According to Professor Saul Rosenthal, the chairman of the working group, the attendees will specify biological end points

and exposure systems for bioeffect studies of low intensity millimeter waves. The objective, he said, is to ensure that "the results of an experiment done anywhere in the world are clear, making replication more feasible."

Rosenthal hopes to organize other, similar meetings to select parameters for experiments in other frequency ranges.

The symposium will resemble a Gordon conference, with no published proceedings in order to encourage a free exchange of ideas. Although attendance is by invitation only, interested experts are encouraged to apply. Some 30-40 scientists are expected.

For more information contact the symposium chairman, Dr. Fritz Keilmann, Max-Planck Institut für Festkörperforschung, 7000 Stuttgart 80, West Germany or Professor Saul Rosenthal, Polytechnic Institute of New York, Route 110, Farmingdale, NY 11735, (516) 454-5074. URSI stands for the International Union of Radio Science. ●

NAS-NRC Studies on Atmospheric Electricity and Emergency Communications Systems

The National Academy of Sciences (NAS) has begun a study of the atmospheric electrical environment. The Geophysics Study Committee of the NAS's National Research Council (NRC) will review recent advances in lightning and cloud physics and electrical phenomena in the atmosphere from an interdisciplinary perspective.

One topic to be addressed by the committee is a revision of lightning protection methods. Recent measurements of electromagnetic signatures indicate that lightning current rise times are about an order of magnitude faster than the present engineering test standards.

The chairmen of the study group are Dr. E. Philip Krider of the Institute of Atmospheric Physics at the University of Arizona, Tucson, and Dr. Raymond Roble of the National Center for Atmospheric Research in Boulder, CO. Background scientific papers for the study will be presented at the American Geophysical Union meeting in Baltimore this June.

The NRC's Committee on Review of National Communications System Initiatives in Support of National Security Telecommunications Policy has published an interim report on the problems of establishing an emergency communications system in an increasingly competitive industry. Electromagnetic pulse (EMP) effects will be addressed in a second interim report due later this year. (Another NRC committee is studying the EMP threat to electronic systems, see *MWN*, April 1983.) The committee is chaired by Professor Louis Rader of the University of Virginia.

National Joint Planning for Reliable Emergency Communications is available from the National Academy Press, 2101 Constitution Avenue, NW, Washington, DC 20418. ●

UPDATES

Biological Effects... Three researchers at the University of Rochester School of Medicine believe they have experimental support for the new RF/MW ANSI safety standard. Writing in the April 15 issue of *Science*, Drs. Norbert Roberts, Jr., Shin-Tsu Lu and Sol Michaelson report finding no significant changes in the viability or function of human mononuclear leukocytes (white blood cells) up to one week after a two-hour exposure to 2450 MHz continuous wave (CW) radiation. Because the ANSI standard is based on a committee consensus that hazardous effects are associated with a whole-body average specific absorption rate (SARs) above 4 W/Kg and because the Rochester group exposed the leukocytes to an SAR equivalent to 4 W/Kg, they interpret their results as presenting "no evidence that current safety standard recommendations are inappropriate." They are careful to acknowledge the limited applicability of their studies: "Direct extrapolation to the in vivo setting with many physiological, homeostatic, integrated systems is not appropriate," and later, "Not

completely excluded are potential microwave-induced effects resulting from exposure at similar SARs but different wave forms (frequencies, modulations and so on)." Nevertheless, they clearly state the opinion that: "earlier reports of possible microwave effects on human leukocytes ...should not form a basis for the resetting of safety standards." Three studies are cited as these "earlier reports." Two are by Dr. W. Stodolnik-Baranska of the Medical Academy of Warsaw, Poland, and appear in *Nature* (214, 102, 1967) and in *Biologic Effects and Health Hazards of Microwave Radiation* (Warsaw: Polish Medical Publishers, 1974). The third paper is by Dr. Przemyslaw Czernski and details some of his work at the National Research Institute of Mother and Child in Warsaw, Poland (he is now at the FDA's National Center for Devices and Radiological Health in Rockville, MD), and is published in the *Annals of the New York Academy of Sciences* (247, 232, 1975). In all three studies, Stodolnik-Baranska and Czernski used pulsed, not CW, 2950 MHz microwaves. The

two most recent studies specify the same pulsing characteristics: a 1200 Hz repetition rate with a 1 microsecond pulse width. The Polish researchers used wave forms that the Rochester group says cannot be "excluded" from being biologically active. In a telephone interview, Michaelson told *Microwave News* that while, in his opinion no one has really demonstrated a difference in biological activity between pulsed and CW radiation, enough people do believe that "a direct comparison may not be appropriate." Thus the Polish and Rochester work may not be comparable, which leaves open the question of the adequacy of present standards for pulsed fields.... A new study, which will appear soon, shows the importance of modulation in producing an effect from exposure to RF/MW radiation. Drs. Daniel Lyle, Patricia Schechter, W. Ross Adey and Robert Lundak have observed an inhibition of immune function, specifically T-lymphocyte cytotoxicity, in the presence of a 450 MHz field sinusoidally amplitude modulated at 60 Hz. (A T-lymphocyte is one type of leukocyte or white blood cell.) They report that, "The unmodulated carrier wave did not affect cytotoxicity." The effect was weaker at lower and higher modulation frequencies, indicating the existence of a frequency "window" effect centered at 60 Hz. The paper has been accepted for publication in *Bioelectromagnetics* (Volume 4, Number 3) and is scheduled to appear late this summer. Lyle is based at the University of California, Riverside.... The air force has awarded Drs. Ernest Albert and Frank Slaby \$186,000 for a two-year study of the interaction of microwaves with the secretory products (e.g. ACTH) of the anterior pituitary cells using electron microscopy and biochemical assays. The two researchers, who are with the Department of Anatomy at George Washington University, will use radiation between 900 MHz and 3 GHz at power densities ranging from 10 uW/cm² to 100 mW/cm².... The Bioelectromagnetics Society (BEMS) has scheduled workshops on the bioeffects of 60 Hz electromagnetic fields, the use of TEM cells in dosimetry studies, the effects of RF radiation on calcium movement and the interaction of RF radiation with thermophysiology and homeostasis at the June BEMS meeting in Boulder, CO; see Conference Calendar.

Communications... An FCC proposal for relocating 12 GHz private microwave operators displaced by DBS has received plenty of bad reviews. Broadcasters fear a commission plan to allocate spectrum space by the technical characteristics of transmission rather than by type of use may land some 12 GHz orphans on their turf at 2 and 7 GHz, and lead to congestion and coordination problems. Comments submitted on the proposal are summarized in the April 4 *Broadcasting*.... The *IEEE Journal of Oceanic Engineering* will devote its July 1984 issue to ELF communications. For more information, contact M.L. Burrows, MIT Lincoln Laboratory, PO Box 73, Lexington, MA 02173.... To meet the fast-growing demand for cordless phones, the FCC has proposed to temporarily allocate frequencies at 46 and 49 MHz. Telephones operating at these frequencies could be marketed for six years while the commission seeks a permanent home for cordless service.... The FCC has eliminated many restrictions on FM radio subcarrier use, clearing the way for new radio paging services.

Compatibility & Interference... The FCC is getting ready to crack down on manufacturers and retailers of microcomputers that fail to meet commission RFI standards, according to a story in the April 25 *Electronic News*. Joseph Casey, the chief of the FCC Field Operations Bureau's investigation branch, cited 1982 surveys which indicated some 30 percent of the 317 RF devices tested violated emission limits—most of the offending equipment was personal computers and peripherals. Commission staff issued 44 citations to vendors; penalties can go as high as \$2,000 per violation per day. Casey said another survey will begin soon.... Even if your computer meets FCC standards, routine emissions may be strong enough to be detected and decoded by sophisticated listening equipment. In an April 5 article in the *New York Times*, William Broad provides some details about the Tempest program, which the super-secret National Security Agency describes as "an unclassified short name referring to investigations and studies of compromising emanations." With respect to how close one must get to a computer to decode its RF signals, Broad quotes Anthony Genova of Chometrics Inc. in Woburn, MA, as saying that "500 feet is not unreasonable at all."... Rome Air Development Center at Griffiss AFB, NY, is seeking proposals for a yearlong study of the possible EMI/EMC impacts of using monolithic microwave integrated circuits in critical command, control and communications systems.... The FCC has adopted final rules for devices that act as interfaces between TV receivers and personal computers or video games. The rules are published in the March 29 *Federal Register* (48 FR 13029).... The Underwriters Laborato-

ries has begun EMI testing at its new facility in Melville, NY.... Two researchers at the Tokyo Central R&D Labs in Japan have published a paper on "Properties of High Frequency Conducted Noise from Automotive Electrical Accessories" in the February issue of the *IEEE Transactions on Electromagnetic Compatibility*.

EMP and Microwave Weapons... William Broad's cover story on EMP, "The Chaos Factor," in the January/February issue of *Science* 83 sparked a number of letters, including one from Defense Secretary Caspar Weinberger. He assured readers that the US has taken steps to protect "certain critical communications systems" from EMP, permitting a "flexible" response to an enemy attack. In another letter, Charles Kinney, a former analyst at the army's Training and Doctrine Command at Fort Monroe, VA, relates his frustrations in trying to alert army staff to the possible threat of a Soviet "directed EMP or high power microwave, coherent beam of immense peak power." He goes on to note that DoD's Directed Energy Program now includes radiofrequency weapons—research "being done under classified wraps at an accelerated pace." (The letters appear in the March issue.) Kinney also wrote an article about particle beam, laser and microwave weapons for the February issue of *Military Electronics/Countermeasures*. He must have gotten his message across: In its recent report, *Soviet Military Power*, DoD notes that: "Indications of Soviet interest in radiofrequency technologies, particularly the capability to develop very high peak-power microwave generators, indicate [sic] that the Soviets intend to develop such a weapon." (p.75) The *Washington Post* confirmed the US is also busy working on these technologies. In an April 17 front page story, Walter Pincus reported that EMP bombs are being developed at the Lawrence Livermore and Los Alamos National Laboratories. And a team from Lawrence Livermore will present a paper on "Dynamic Characteristics of Intense Short Microwave Propagation in Atmosphere and Air Breakdown Threshold" at the classified HEART conference on July 21 in Oak Ridge, TN (see Conference Calendar on p.8).... Daniel Stein, a physicist at Princeton University, writes about EMP weapons policy in the March *Bulletin of Atomic Scientists*.... Corning has developed glass dielectric capacitors that have significant immunity to EMP. For more information, contact Corning's Ronald Demcko at (919) 876-1100.

Government... At an April 14 meeting in Washington, DC, EPA's Office of Radiation Programs offered a working draft of its RF/MW exposure guidance for review by an inter-agency group. EPA staff briefed the group on progress toward completing the proposed guidelines, which are due this fall.... As expected, the charter of NTIA's Frequency Management Advisory Council (FMAC) has been renewed for another two years. For more information, contact Charles Hutchison at NTIA, (202) 377-0805.

International... Last month we reported that the Standards Association of Australia (SAA) has proposed new RF/MW safety limits identical to the revised 1982 ANSI standard for workers. For the general population, the limits would be a factor of ten lower. The Australian Council of Trade Unions (ACTU) has now filed comments objecting to the SAA draft. The ACTU wants the standard's frequency range to be extended down to 50 Hz because of recent reports linking power line radiation to leukemia. Citing an ongoing study of the health of radio linemen by the Australian Postal and Telecommunications Union, the ACTU states that there is already evidence confirming the existence of "radiowave disease." The council argues: "The conclusion reached by the [SAA] that non-thermal effects are insignificant and can be ignored is a view that cannot be sustained, is not scientifically or medically valid and is certainly not shared by either the ACTU or bodies like NIOSH or WHO." The ACTU offers a counter-proposal: the adoption of the new Soviet standard for occupational exposures (25 uW/cm² for 8 hours for 300-3,000 MHz, see *MWN*, November 1982 for details) and 10 uW/cm² for the general population.

Litigation... Marc Moller, a lawyer with Kreindler & Kreindler in New York City, will be the luncheon speaker at the International Microwave Power Institute symposium in Philadelphia on July 20 (see Conference Calendar on p.8 for details). He will discuss "Litigation Implications of Microwave Exposure and Personal Injury Claims." Moller was the lead attorney on the Engel-TACAN pancreatic cancer suit, which was settled out of court last December (see *MWN*, January/February 1983).

Measurement... The proceedings of the 1982 *Conference on Precision Electromagnetic Measurements* appear in the March issue of *IEEE Trans-*

actions on Instrumentation and Measurement. The collection includes more than 60 papers presented at the Boulder, CO, meeting last June 30-July 1....NBS expects to complete its draft laboratory accreditation handbook for electromagnetic calibration services by the fall. Details on its relationship to a possible Measurement Assurance Program (MAP) are still being developed (see *MWN*, November 1982). For more information, contact: NBS' John Locke, (301) 921-3431....Among the papers scheduled to be presented at the International Microwave Power Institute (IMPI) symposium in July (see Conference Calendar on p. 8 for details), there are three on measurement techniques. Edward Aslan of Narda Microwave Corp. in Hauppauge, NY: "An Inexpensive Leakage Monitor;" Arnold Bucksbaum of Amana Refrigeration Inc. in Amana, IA: "A Leak Source for Evaluating Radiation Monitors;" and Billy Nesmith of FDA's National Center for Devices and Radiological Health in Rockville, MD: "Performance Evaluation of High-Power Survey Instruments."

Medical Applications...At the University of Pennsylvania, Professors Shiro Takashima and Toshio Asakura have succeeded in reversing the sickling of red cells with a pulsed low frequency field, a first step towards a temporary treatment for sickle cell anemia. Their working hypothesis is that the field causes changes in the cell membrane inducing an uptake of water. According to their report in the April 22 *Science*, the field strength was high: 3.5 kV/cm with a pulse duration of 5 milliseconds and an interval of 1 second. In a telephone interview, Takashima said that once the ground work is completed, they would like to run some experiments with rabbits or rats. For the moment, however, they must overcome the problem posed by the lysing of the red cells after 30 minutes of exposure....Two papers on applicators for hyperthermia treatment appear in the March issue of *Physics in Medicine and Biology*. Dr. J. Conway of Sheffield University in the UK assesses a small microwave diathermy applicator for treating tumors and a team from the University of Utah in the US presents applicator designs for regional and whole-body hyperthermia....The American Association of Physicists in Medicine (AAPM) has published *Physical Aspects of Hyperthermia*, edited by Dr. Gilbert Nussbaum of Washington University School of Medicine in St. Louis, MO. The volume, which consists of papers used at the AAPM's 1981 summer school at Dartmouth College, is available for \$50 from the American Institute of Physics, Dept. BN, 335 East 45 Street, New York, NY 10017....The Association for the Advancement of Medical Instrumentation is holding a session on "Hyperthermia Therapy for Cancer" at its annual meeting on May 23. And there will be a workshop on "Hyperthermia for Cancer Treatment" on May 31 just before the *International Microwave Symposium* begins in Boston. For information on the latter course, contact MIT's Professor P. Lele (617) 253-5235. For details on both conferences see the calendar on p.8.

Ovens...Details of a microwave oven injury have been reported by Dr. Henry Fleck, associate professor of rehabilitation medicine emeritus at Albert Einstein College of Medicine in Bronx, NY. Writing in the April issue of the *Bulletin of the New York Academy of Medicine*, Fleck describes the burns suffered by a 51-year-old woman who opened the door and stuck her hands and forearms into the still active oven. In the process of retrieving a food dish, she was exposed to radiation from the oven's 600-watt magnetron for a few seconds. Over four years after the 1977 accident, the woman still experienced pain when her hands and forearms were exposed to radiant energy. Fleck suggests that a "simple neon tube" should be incorporated into microwave ovens as a radiation detector. This would enhance their safety, he argues, especially as they wear down....The May issue of *Consumer Reports* features a survey of 17 popular models of counter-top microwave ovens tested for speed, efficiency, cooking uniformity, convenience and accuracy of controls and safety. The Panasonic and Quasar scored highest in overall quality. All units met federal safety standards for radiation leakage....The Association of Home Appliance Manufacturers reports that the microwave oven industry had its best March in history: some 356,500 ovens were shipped, a 20 percent increase over last year. Nearly a million microwave ovens have been shipped so far this year....According to an April 11 report in *Home Furnishings Daily*, the microwave industry is gearing up for a strong second quarter also.

Power Lines...The New York State Power Lines Project's scientific advisory panel will consider funding three epidemiological studies on the health effects associated with exposure to 60 Hz fields. At its March 27 meeting, the group reviewed over ten pre-proposals and requested full

proposals from Dr. Lowell Sever of Battelle in Richland, WA; Dr. Tim Byers of the State University of NY, Buffalo; and Drs. Jerome Barancik, Sam Morris and Leonard Hamilton of the Brookhaven National Laboratory in Upton, NY. The panel also reviewed a report by consultant Dr. Annemarie Crocetti on the advisability of reanalyzing Dr. Nancy Wertheimer's data linking power line radiation to cancer. Crocetti has recommended that the project fund a new study modeled after Wertheimer's. The panel's Dr. James Stebbings has asked Dr. Richard Hamman at the University of Colorado, Denver, to submit a proposal for this study. Project administrator Michael Rampolla hopes to receive all the proposals by the end of May.

Satellite Communications...On April 28, New York City's Board of Estimate gave final clearance for Teleport, a massive satellite communications complex. A joint venture of the Port Authority of New York and New Jersey, Merrill Lynch and Western Union, Teleport could accommodate up to 17 earth stations at its Staten Island site and cost hundreds of millions of dollars (see *MWN*, January/February 1983). Construction is scheduled to begin almost immediately.

Standards...The Institute of Electrical and Electronics Engineers (IEEE) has issued standard 475-1983 *Measurement Procedure for Field Disturbance Sensors*. The standard describes a method of measuring the RF radiated field strength (including the fundamental frequency and its second and third harmonics as well as any non-harmonic spurious emissions) from intrusion alarm, microwave-type sensors in the frequency range 300 MHz-40 GHz. It also specifies how to measure power line noise between 30 and 300 MHz. A copy of the standard, which was developed by the IEEE's Electromagnetic Compatibility Society, is available for \$6 from Margaret Lynch, IEEE, 345 East 47 St., New York, NY 10017....The Electronic Industries Association's (EIA) Committee on Electron Tube Safety has developed two new standards: *Recommended Practice for Measurement of X-Radiation from Projection Cathode Ray Tubes* (RS-500) and *Recommended Practice for Measurement of X-Radiation from Non-Raster-Scanned Direct View Cathode Ray Tubes* (RS-502). Copies are available for \$5 each from EIA, Standard Sales Dept., 2001 Eye St., NW, Washington, DC 20006.

VDTs...Newspaper Guild labor contracts may be the first in the US to guarantee VDT workers the right to alternative work during pregnancy. In a report prepared for the guild national convention in June, the union's executive board advises that "locals have the option to seek provisions enabling pregnant employees to be reassigned from working conditions the employee believes may be hazardous to her unborn child or herself by reason of her pregnancy."...The union has also written model VDT legislation which would require shielding plastic-cased terminals to reduce radiation emissions. The main concern of the proposed regulations, however, is ergonomics. The proposed guild legislation includes guidelines for lighting, furniture and terminal design, annual eye exams and hourly breaks from VDT work....A survey of workers at Harvard University's medical, dental and public health schools links VDT use to headaches, stress and eye, neck and back pain. A report on the study by the United Auto Workers (UAW) Committee on New Office Technology for the Harvard Medical Area and a list of guidelines for VDT use are available from the Boston UAW at (617) 236-1793....A committee set up under the American National Standards Institute's (ANSI) Safety and Health Management Board has begun work on a VDT ergonomics standard. The ten-member group, chaired by Professor Harry Snyder of the Virginia Polytechnic Institute, in Blacksburg, plans to have a draft standard ready for circulation and review by year-end, but is unlikely to submit a final guideline to ANSI for some time. The committee includes members of the academic community and representatives from IBM, Digital Equipment, Telectronics and Hewlett Packard....The Planetary Association for Clean Energy (PACE) is sponsoring a second VDT conference in Ottawa, October 21-23. For information, contact PACE, 100 Bronson Ave., Suite 1001, Ottawa, Ontario, Canada K1R 6G8, (613) 236-6265. Concern over possible ELF radiation hazards was a major topic at last year's conference....Dr. T.J. Stobbe of West Virginia University will chair a session on ergonomics and the office environment on May 24 at the *American Industrial Hygiene Conference* in Philadelphia, May 22-27....As reported last month, VDT tests at Surrey Memorial Hospital in Vancouver, BC, focused on the pulsed, very low frequency (VLF) radiation emitted by flyback transformers. Asked about measurements made in the US, Bill Murray of NIOSH told *Microwave News* that he knew of no meter that can

accurately measure these emissions in a work place, and that NIOSH relies on FDA laboratory tests to estimate VLF radiation exposure. Growing concern that reported clusters of pregnancy problems among VDT users may be linked to pulsed VLF radiation has not altered NIOSH's position that there are no VDT radiation hazards and that no further radiation testing is warranted. Murray explained that VDT emissions can't produce significant heating, and that teratological studies at NIOSH "show no evidence of non-thermal effects."...An article in the April *Harvard Medical School Health Letter* based on material from Michael Smith at NIOSH states that the clusters are "quite likely to be the result of a statistical accident, not VDT exposure." Other concerns, however, require attention: "The VDT is not just another piece of office equipment; it changes the nature of the work people do. Most potential health problems caused by VDTs can probably be averted by planning that takes account of the operators' needs. Lighting and furniture at the worksite may need to be rearranged or redesigned to prevent eyestrain and postural stresses. Operators need to have frequent breaks, to be able to move about, to work at a variable pace, and to meet the requirements set by human capacity, not a computer's. There are many opportunities to avoid becoming a 'terminal case'."

Etc...Last December we noted the publication of *Risk/Benefit Analysis: The Microwave Case* by San Francisco Press. One of the papers in this collection, written by Dr. Zory Glaser and Christopher Dodge, contained some editing and printing errors. A corrected copy is available from Glaser, Division of Risk Assessment, FDA (HFX-130), 12709 Twinbrook Parkway, Rockville, MD 20857. Please include a 6x9 self-addressed, stamped envelope. ●

ANSI RFI Task Group (continued from p.1)

C63 committee, said that the IEEE Standards Board had asked C63 to take up the RFI immunity problem noting that if ANSI did not, the IEEE would. Showers advised the committee to accept the challenge. The C63 members then unanimously agreed to develop standards and recommended practices, as appropriate, taking into account the interests of manufacturers, users, consumers and government agencies.

The task group's priority list of home electronic equipment is, in order of importance: TV receivers including videotape cassette recorders, hi-fi equipment including radio receivers, personal computers and other personal entertainment equipment. (For other news of C63 activities, see p.2.)

ARRL's Williams said that he also wants the ANSI group to explore touch control lamps, cordless telephones and radio controlled lighting systems. Turnbull would like to add smoke detectors, security systems and "non-Bell" telephones to the list. ●

LETTERS

To the Editor: We much appreciated receiving a copy of *Microwave News* [March 1983] in which our electromagnetic field studies were discussed. This is a new research area, most intriguing and challenging, which naturally elicits controversy.

At present we have sent 17 abstracts of EMF studies performed in different species, for past and future meetings, and have five papers (two published, one in press in the *Journal of Anatomy* confirming our initial findings, and two more submitted for publication).

We are already in correspondence with Richard Tell and look forward to further exchange of ideas and information with others who commented on our work in the *Microwave News* article which was very useful for our group.

Jose M.R. Delgado, MD
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Microwave News invites letters from readers. We ask writers to be brief, and we reserve the right to edit contributions for length.

CONFERENCE CALENDAR

- May 15-19: 15th Annual Meeting of the Conference of Radiation Control Program Directors, Eldorado Hotel, Reno, NV. Contact: Charles Hardin, CRCPD, 65 Fountain Place, Frankfort, KY 40601.
- May 22-25: 18th Annual Meeting of the Association for the Advancement of Medical Instrumentation, Loews Anatole, Dallas, TX. Contact: AAMI, Suite 602, 1901 N. Fort Myer Drive, Arlington, VA 22209.
- May 22-27: American Industrial Hygiene Conference, Philadelphia Civic Center, PA. Contact: AIHA, 475 Wolf Ledges Parkway, Akron, OH 44311.
- 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, Houston, TX 77004.
- June 1-3: IEEE/MTT-S International Microwave Symposium, Sheraton Boston Hotel, Boston, MA. Contact: Frank Leith, Alpha Industries, 20 Sylvan Road, Woburn, MA 01801.
- June 5-9: International Conference on Nonlinear Electrodynamics in Biological Systems, VA Hospital, Loma Linda, CA. Contact: Research Service (151), Jerry L. Pettis Memorial Veterans Hospital, 11201 Benton Street, Loma Linda, CA 92357.
- June 7-9: 3rd International Conference on Satellite Systems for Mobile Communications and Navigation, London, UK. Contact: Institution of Electrical Engineers, Savoy Place, London WC2R 0BL, United Kingdom.
- June 12-16: 5th Annual Bioelectromagnetics Society Meeting, University of Colorado, Boulder, CO. Contact: BEMS, 1 Bank Street, Gaithersburg, MD 20878.
- June 19-23: 28th Annual Health Physics Society Meeting, Baltimore Hilton Hotel and Convention Center, Baltimore, MD. Contact: HPS, 4720 Montgomery Lane, Suite 506, Bethesda, MD 20814.
- June 21-23: International Conference on Lightning and Static Electricity, Fort Worth Hilton Hotel, TX. Contact: Nick Rasch, FAA Technical Center, ACT-340, Atlantic City Airport, NJ 08405.
- July 3-8: 7th International Congress of Radiation Research, Amsterdam, Netherlands. Contact: Dr. J.J. Broerse, Radiobiological Institute TNO, PO Box 5815, 2280 HV Rijswijk, Netherlands.
- July 18-21: 20th Annual IEEE Conference on Nuclear and Space Radiation Effects, Sheraton Gatlinburg Hotel, Gatlinburg, TN. Contact: E.F. Hartman, Div. 9336, Sandia National Laboratories, Albuquerque, NM 87185.
- July 18-22: 7th International Symposium on Bioelectrochemistry and Bioenergetics, Stuttgart, West Germany. Contact: Professor M. Blank, Department of Physiology, Columbia University Medical School, 630 West 168th Street, New York, NY 10032.
- July 18-22: 18th Annual Microwave Power Symposium, Franklin Plaza Hotel, Philadelphia, PA. Contact: International Microwave Power Institute, Tower Suite 520, 301 Maple Avenue West, Vienna, VA 22180.
- July 21-22: 2nd Annual Hardened Electronics and Radiation Technology (HEART) Conference, Oak Ridge National Laboratory, Oak Ridge, TN. Classified clearance required to attend. Contact: James E. Gover, Div. 2155, Sandia National Laboratories, Albuquerque, NM 87185.
- 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.
- August 23-26: URSI International Symposium in Electromagnetic Theory, Santiago de Compostela, Spain. Contact: Dr. J.L. Sebastian, Dept. de Electricidad y Electronica, Facultad de Ciencias Fisicas, Ciudad Universitaria, Madrid (3), Spain.
- September 4-6: URSI Symposium on Techniques in Studies of Biological Effects of Low-Level Millimeter Waves, Herrsching, West Germany (near Munich). Contact: Professor Saul Rosenthal, Polytechnic Institute of New York, Route 110, Farmingdale, NY 11735.
- September 12-14: 36th Annual Conference on Engineering in Medicine and Biology, Hyatt Regency Hotel, Columbus, OH. Contact: Alliance for Engineering in Medicine and Biology, 4405 East-West Highway, Suite 210, Bethesda, MD 20814.
- October 2-5: 3rd Annual Meeting of the Bioelectrical Repair and Growth Society, San Francisco, CA. Contact: Dr. Lorraine Day, San Francisco General Hospital, 1001 Potrero, San Francisco, CA 94110.
- October 4-6: 7th International Colloquium on Prevention of Occupational Risks due to Electricity: The Prevention of Electrical Accidents by Influencing Human Behavior, Cologne, West Germany. Contact: Secretariat of ISSA-Section and Colloquium, Berufsgenossenschaft der Feinmechanik und Elektrotechnik, Gustav-Heinemann-Ufer 130, D-5000 Köln 51, West Germany.