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INSIDE...

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.

New Soviet Population Standard: 10 uW/cm² at MW Frequencies

The Soviet Union has relaxed its standard for the exposure of the general population to radiofrequency and microwave (RF/MW) radiation. At microwave frequencies (300 MHz-30 GHz), the standard has doubled from 5 uW/cm² to 10 uW/cm². This new level is still as much as 500 times more stringent than the guidelines set by the American National Standards Institute (ANSI).

At lower frequencies, the exposure standard is only a little weaker than the one adopted in 1978. For instance, for 30-300 MHz, the maximum permissible limit was increased from 2 V/m to 3 V/m (see Table). For frequencies below 30 MHz, the exposure limits are given in terms of the electric field, without specifying a limit for the magnetic field.

The revised standard was set by a committee chaired by Professor M.G. Shandala, the director of the A.N. Marzeev Research Institute for General and Communal Hygiene in Kiev. A translation of the standard appears on pp.2-5.

In Section 1.4, it is stated that the standard covers frequencies up to 300 GHz, but no limit is actually specified for 30-300 GHz. The 1978 standard cites the same value for this band as for the 300 MHz-30 GHz band.

Unlike U.S. and Western standards, the Soviet standard includes limits for certain types of pulsed radiation sources.

The Soviet occupational standard is 100 uW/cm² for two-hour exposures to radiation in the 300 MHz-300 GHz frequency band (see *MWN*, September 1983).

Maximum Permissible Levels (MPLs)

Frequency	1978	1984
30-300 kHz	20 V/m	25 V/m
300 kHz-3 MHz	10 V/m	15 V/m
3-30 MHz	4 V/m	10 V/m
30-300 MHz	2 V/m	3 V/m
300 MHz-3 GHz	5 uW/cm²	10 uW/cm²
3-30 GHz	5 uW/cm²	10 uW/cm²
30-300 GHz	5 uW/cm²	Not Specified

EXCERPTS

Soviet General Population RF/MW Radiation Exposure Standard

Reprinted below are excerpts from the 1984 Soviet standard for general population exposures to radiofrequency and microwave (RF/MW) radiation. This standard, which replaces the 1978 version, was sent to Microwave News *by Professor M.G. Shandala, director of the A.N. Marzeev Research Institute for General and Communal Hygiene in Kiev. The regulations are interim and must be reviewed in five years in light of new bioeffects data.*

The standard was translated from the original Russian by Microwave News. *Every effort has been made to convey the meaning of the original text in the translation, but some parts of the standard were not clear and their interpretation remains open to question. Table 3.2 has been omitted here; it presents operational details (including allowances for duty factors) for specific types of Soviet radars.*

Any subscriber who would like a copy of the standard in the original Russian should send Microwave News *a check for $7.50, together with a mailing label. The cost for non-subscribers is $25.00 (prepaid). Please note that the original copy is mimeographed and certain parts are hard to decipher.*

U.S.S.R. Ministry of Health, Central Health and Epidemiological Administration

Interim Health Standards and Regulations on Protecting the General Population from the Effects of Electromagnetic Fields Generated by Radiotransmitting Equipment, Moscow–1984

(Approved by the Chief State Physician of the U.S.S.R., P.N. Burgasov, January 19, 1984; No. 2963-84)

1. General

1.1 These health standards and regulations ("Regulations") for protecting populations from the effects of electromagnetic fields (EMF) generated by installations with radiotransmitting equipment (RTE) determine the health protection requirements for radio, television and radar stations, and other types of equipment that belong to ministries, administrations, institutions and organizations and that radiate electromagnetic (EM) energy into the environment. These Regulations cover existing residential areas and housing projects, public and industrial buildings, and public recreation areas located in the vicinity of existing sources of radiofrequency EM energy or those under design or construction.[1]

1.2 The ministries, administrations, institutions and organizations that use, construct or design RTE installations that radiate EM energy are responsible for implementing these Regulations. The planning and construction of projects in areas where RTE is located will be the responsibility of local administrative bodies. Responsibility for design and construction of residential and civil buildings in restricted areas will be carried out by the organizations performing the design and construction.

1.3 The Health and Epidemiological Administration (HEA) of the USSR Ministry of Health, the Ministries of Health of the Union Republics, and the medical services of other ministries and departments are responsible for supervising and controlling application of these Regulations.

1.4 The maximum permissible EMF levels established by these Regulations cover the frequency range 30 kHz-300 GHz.

1.5 Failure to follow these Regulations may result in a condition exposing populations to the harmful effects of EMF. To prevent this, a set of maximum permissible EMF levels and health regulations must be applied to RTE sites. The main principles of these requirements are contained in these Regulations.

2. Units of Measurement

2.1 EM energy emitted by a RTE antenna spreads into space, forming an EMF characterized by the component electric (E) and magnetic (H) fields.

2.2 The EMF within bands 5-8 [30 kHz-300 MHz] is to be designated by the electric field strength, the measuring unit being volts/meter (V/m).[2]

2.3 Within the bands 9-11 [300 MHz-300 GHz], current measurement methods use power density (PD), with the unit watts per square meter (W/m^2) [1 W/m^2 = 0.1 mW/cm^2 = 100 uW/cm^2].

3. Maximum Permissible Levels (MPLs) of EMF in Populated Areas

3.1 In the frequency range 30 kHz-30 GHz, the MPLs for the effective electric field strength or the average PD are tabulated by band in Table 3.1.

3.2 The MPLs in bands 9-11 for pulsed emissions into populated areas adjacent to active radar stations, projects under construction at any design stage and areas of future construction near active radar stations should not exceed the permissible levels shown in Table 3.2. [Omitted]

3.3 For RTE types not listed under Table 3.2, the EMF in settled areas should not exceed 10 uW/cm^2. The same is true for pulsed radars operating in the 150-300 MHz range.

3.4 In existing populated areas adjacent to RTE sites installed before approval of these Regulations, the MPLs can be exceeded until the necessary protective steps are

1. These regulations do not cover mobile radio stations, household electrical appliances and medical devices that radiate EM energy.

2. For populated areas, the magnetic field limits have not been specified in these regulations.

implemented if agreed to by the USSR Ministry of Health, the Ministries of Health of the Union Republics and the owners of the RTE.

3.5 Organizations and institutions using RTE not meeting these Regulations should, together with the local Soviet authorities, devise and implement a plan with the HEA of the USSR Ministry of Health and the Ministries of Health of the Union Republics for normalizing the electromagnetic environment in the adjacent areas.

4. Requirements for Siting RTE and for Establishing Health Protection Zones (HPZ) and Restricted Construction Zones (RCZ)

4.1 Areas for siting RTE should be selected taking account of transmitter power, directional characteristics, height and design characteristics of the source, the nature of the area and the use of the adjacent areas — in order not to exceed the MPLs noted in Section 3 for populated areas.

4.2 RTE areas are to be established according to the applicable Regulations; residential complexes and public buildings are not to be allowed in these areas.

4.3 To protect populations from the effects of EMF generated by RTE, the HPZ and the RCZ are to be established, if necessary.

4.4 An HPZ is an area adjacent to the territory occupied by RTE. The outer HPZ boundary is determined at a height 2 meters above ground, in accordance with the MPLs noted in Section 3.

4.5 An HPZ is established by considering the EM emission source; that is, the transmitting equipment and the prospects for growth. Use of the HPZ is regulated by "Health Regulations in Design of Industrial Plants," SP245-71.

4.6 Public services and amenities in an HPZ are to be organized according to the "Environmental Protection Measures" of RTE design.

4.7 An RCZ is an area with EMF levels, measured at a height of 2 meters or more above ground, that exceed the levels in Section 3. The outer RCZ boundary is defined by the highest floor in a proposed building where the EMF would not exceed the MPLs noted in Section 3.

4.8 HPZs and RCZs are to be established in accordance with the methods given in the appendix [omitted in version received]. The HPZ and the RCZ boundaries are to be defined more exactly by actual measurements at the time of the project's approval.

4.9 The HPZ and the RCZ are to be established for transmitting stations with antennas that are non-directional in the horizontal plane, for television stations and for scanning radars.

4.10 For stations equipped with directional antennas and radars scanning in defined sectors or fixed in one direction, the HPZ and the RCZ are established in the principal direction of emission, but sidelobe and backlobe levels should also be taken into account in calculations.

4.11 For radio, television and radar stations transmitting energy in defined directions, the EMF levels depend on the height above ground level, and the RCZ should be set incrementally for every height in the building's vertical dimension.

4.12 To reduce radiation levels in an area and to decrease the HPZ size, stations should be built on natural protuberances, high ground, hills, etc., to minimize the use of transmitting directions making negative angles with the horizon.

4.13 Planning and development at active sites and those in the design stage involving RTE must be layed out with defined HPZs and RCZs as established in approved RTE projects.

5. Building in a RCZ

5.1 Within a RCZ, various uses are allowed if EMF levels do not exceed those given in Section 3. To comply with these regulations, protective measures should be used to reduce EMF levels below the MPLs.

5.2 In a RCZ, medical buildings, kindergartens, schools and homes for the elderly and handicapped should

Table 3.1

Maximum Permissible Levels (MPLs) for Exposure to Electromagnetic Fields

Band	Frequency Range	MPLs
5	30-300 kHz	25 V/m
6	300 kHz-3 MHz	15 V/m
7	3-30 MHz	10 V/m
8	30-300 MHz	3 V/m
9	300 MHz-3 GHz	10 uW/cm^2
10	3-30 GHz	10 uW/cm^2
11	30-300 GHz	Not Specified

be located in low radiation areas.

5.3 Designers should specify ways of reducing levels below the MPLs given in Section 3.

5.4 When siting new buildings in a RCZ, consideration should be given to the possibility of reducing EMF levels in playgrounds by using buildings and other types of construction for shielding, and in building interiors, by building the facade with the minimum area of glass windows facing the radiation source. If necessary, balcony-type buildings should be planned with living quarters on the side opposite to the radiation source.

5.5 In the design of a building located in a RCZ, the density of construction should be at the lower end of that permitted in the appropriate regulations.

5.6 In a RCZ, the roofs of industrial and residential buildings should be covered with protective structures of good shielding materials (like reinforced concrete) or with grounded metallic nets. Use of protective walls, canopies, and deep depressions should also be considered.

5.7 RCZ areas should be planted with the maximum amount of greenery, and paved roads and pedestrian paths should be minimized. Preference should be given to sand, clay and gravel surfaces.

6. EM Control Methods in the Environment

6.1 Controlling the permissible EMF level is done by the HEA of the USSR Ministry of Health, the Ministries of Health of the Union Republics and by medical specialists in other ministries during the design stages of buildings, during the construction of RTE and in the areas adjacent to the active and proposed installations.

6.2 Project documentation in a section called "Environmental Protection Measures" should contain the results obtained in calculating HPZ and RCZ boundaries and also the data being used for these calculations.

6.3 The EMF calculations should take into account the height of the RTE transmitter and its distance to existing and planned construction. The local topography should also be taken into account.

6.4 If RTE installations are equipped with transmitters and receivers working within bands 5-8 [30 kHz-300 MHz], the total field strength in each of these bands is determined by the following formula:

$$Es = \sqrt{\sum (Ei)^2}$$

where Es = root-mean-square sum field strength; and
Ei = field strength generated by ith transmitter at the defined point in the specific band.

*Similarly, the total PD in the adjacent area for bands 9-11 [300 MHz-300 GHz] is determined by the following formula:

$$PDs = \sum PDj$$

where PDs = total power density; and
PDj = PD generated by jth transmitter at the defined point.

6.5 When several radiation sources are operating in different bands, the total field created by all sources at the HPZ boundary must be calculated by the following formula:

$$\sum (Ei/Emi)^2 + \sum (Pj/PDmj) = 1$$

where Ei = the fields from the individual sources;
PDj = the individual PDs;
Emi = the MPL associated with the ith source; and
PDmj = the PD MPL associated with the jth source.

6.6 When a residential complex or an individual building is designed to be in an area with RTE, calculating and actually measuring EMF levels should be carried out according to the methods set forth in these Regulations.

6.7 Measurements of EMF levels are required for areas of proposed installations and construction.

6.8 Measurements of EMF levels should be made: • by the owners of RTE together with the representatives of HEA, when the RTE is being approved; • by HEA together with the owners of the RTE, when civil constructions are located in the area adjacent to the RTE being approved; • by HEA together with the owners of the RTE at the time of regular health inspections.

6.9 Every RTE emitting EM energy must have a health certificate containing the following information:

• equipment name; • address; • time of its first activation; • project design and construction data; • a diagram of the installation with location of HPZ and RCZ boundaries; • number, type and power of transmitters; • location of antennas and direction of the beam; • antenna pattern; • height of the antenna measured from ground level; • maximum lobe angle of the antenna; • operating frequencies; • modulation type; • antenna directional diagrams in the horizontal and vertical planes; • time and operating modes; • calculations of distribution of EMF levels in areas adjacent to the RTE; • EMF measurement data indicating measurement equipment used (type and serial number, inspection date); • HEA's conclusions about the installation; • recommendations for normalizing EMF levels (if necessary); • results of carrying out the recommendations of HEA; and • inspection date.

The health certificate should be prepared by the radiotechnical administration, signed by its director, by a representative of the HEA of the USSR Ministry of Health, by the Ministries of Health of the Union Republics and by a representative of medical services of other ministries and registries. The certificate is to be kept at the installation and is to be available to be shown to HEA specialists.

7. "Health Standards and Regulations for the Location of Radio, Television and Radar Stations," No.1823-78, approved February 8, 1978, is void.

8. Methods for Calculating and Measuring EMF and Ways of Determining HPZ and RCZ Boundaries for RTE will be published as a necessary supplement to these Regulations.

9. EMF levels generated by radar stations should be determined according to methods approved by the USSR Ministry of Health and described in the following documents: "Methods for Calculation of the Density of EMF, Dimensions of the HPZ and Placement of Metereological Radars," No.309?-77 [number unclear in original]; "Methods for Calculation of EMF Levels and Health Requirements in Placing VHF, UHF and SHF RTE for Civil Aviation," No.2284-81.

HIGHLIGHTS

Selikoff To Study VDT Reproductive Risks

Dr. Irving Selikoff, a professor at the Mount Sinai School of Medicine in New York City, will direct the first prospective epidemiological study of the reproductive risks associated with working at video display terminals (VDTs). Selikoff is assembling an inter-disciplinary team of researchers to devise a study protocol designed to determine whether VDT radiation causes pregnancy problems. The study is being partially funded by a grant from the March of Dimes.

The Service Employees International Union (SEIU) and 9 to 5, the National Association of Working Women, will collaborate with Selikoff on the VDT project, which will involve 10,000-12,000 women. SEIU volunteers will be asked to complete questionnaires on work patterns, medical histories and lifestyles.

Selikoff's team will field test questionnaires in a six-month feasibility phase beginning in June. Subsequent data collection will take three years, followed by a year of analysis. The study will follow the model developed by the American Cancer Society in its studies on cancer prevention, which included millions of volunteer participants.

At a June 6 press conference announcing the study, Selikoff said that, "Clusters of problem pregnancies have been identified in VDT-intensive offices and questions have been raised as to whether exposure to the non-ionizing radiation emitted by VDTs is involved." The Mount Sinai study will seek to address continuing concern that the clusters are related to VDTs.

Selikoff and his associates at the Environmental Sciences Lab at Mount Sinai have an international reputation in the study of toxic materials, including asbestos, polychlorinated biphenyls (PCBs) and vinyl chloride.

Three other epidemiological studies are also about to begin; they are all retrospective studies, however. In the United States, one team under Dr. Teresa Schnorr of the National Institute for Occupational Safety and Health (NIOSH) and a second team directed by Drs. Bill Butler and Kelly Brix of the University of Michigan each plan to begin distributing questionnaires this summer or fall. In Denmark, researchers at the Marselisborg Hospital in Aarhus and at the Institute of Social Medicine at the University of Aarhus are in the process of identifying 2,000 women who were pregnant in 1983 and 1984 to answer questionnaires.

NBS To Proceed with EMC Lab Accreditation Program

The National Bureau of Standards (NBS) has approved a request to establish a national voluntary laboratory accreditation program (NVLAP) for electromagnetic compatibility (EMC) and telecommunications equipment. The NBS decision follows a January 23 request from Walter Poggi of Retlif Testing Laboratories in Ronkonkoma, NY (see *MWN*, March 1985).

The NBS must now establish viable test methods by which labs can be judged, and the bureau will host a workshop in Gaithersburg, MD, on June 17 to discuss possible methods and criteria for accrediting labs.

Peter Unger, associate manager of NBS's accreditation program, told *Microwave News* that he hopes to have the criteria finalized and the LAP application package available by October.

Poggi has formed a task group to develop draft test methods (for, among others, conducted and radiated emissions) and technical requirements (including quality control, laboratory practices and record keeping) to present at the workshop.

According to the NBS's Jeffrey Horlick, project leader for the EMC LAP, the bureau received 14 sets of comments on Poggi's proposal: 8 were positive, 4 were conditional and 2 were negative.

The majority of those in favor of the LAP represent independent testing labs and believe that a LAP would help win the acceptance of products by foreign countries.

The Computer and Business Equipment Manufacturers Association (CBEMA) and R&B Enterprises opposed the LAP. CBEMA argued that the present procedures are working and that a new LAP would only add administrative expenses. R&B noted that a LAP made little sense due to the lack of agreement among the Army, Air Force and Navy on measurement and instrumentation techniques.

The Electronics Industries Association (two sets), the Naval Electronic Systems Command (NAVALEX) and the Federal Communications Commission all expressed mixed opinions on the need for the LAP. For instance, the NAVALEX told the NBS that the LAP would win its approval as long as it did not apply to the Navy.

The question of fees for participation in the LAP will be decided later. Horlick explained that the costs of laboratory accreditation cannot be computed until the methods and requirements are settled.

For more information, contact NBS's Unger at (301) 921-3431 or Retlif's Poggi at (516) 737-1500.

Voluntary FDA Standard for RF Sealer Workers

The Food and Drug Administration (FDA) has issued voluntary exposure standards for operators of radiofrequency (RF) sealers and dielectric heaters. FDA's recommendation is based on the 1982 American National Standards Institute (ANSI) standard.

The FDA has no authority to enforce its new guidelines. The agency advises that it "believes that the responsibility for implementing these recommendations lies with the owners of new and existing equipment and the manufacturers of new equipment." Only the Occupational Safety and Health Administration (OSHA) can set mandatory federal exposure standards, but it has not done so. Although OSHA has a voluntary 10 mW/cm^2 standard in its rulebook, that standard cannot be enforced (see *MWN*, November 1983 and March 1984).

When asked why the FDA was setting occupational exposure guidelines, William Herman, director of the Division of Physical Sciences, replied, "FDA also has the responsibility for issuing recommendations for radiation emitted by RF devices under the Radiation Control for Health and Safety Act of 1968."

Another reason for the FDA action appears to be prompted by the high radiation levels to which RF sealer operators are exposed. In its cover letter accompanying the standards, the FDA states that RF sealers "often expose operators to time-averaged electric and magnetic field strengths that are *10 to 100 times higher than prevailing voluntary exposure standards* promulgated by ANSI" [emphasis FDA's]. (See *MWN*, January/February 1982.)

The agency could have set a performance standard for RF equipment, but it would only apply to new equipment. At hearings held in May 1981, John Villforth, the director of the FDA's Center for Devices and Radiological Health, told Congress that such an approach would not be the most effective one (see *MWN*, June 1981).

When the exposure guidelines were proposed last year (see *MWN*, September and November 1984), Edward Baier, head of OSHA's Directorate of Technical Support, wrote to the FDA that his agency has no plans to regulate RF radiation but that "we are supportive of voluntary efforts to provide greater worker protection from hazards."

Under the ANSI standard, exposure limits below 3 MHz and above 30 MHz are 100 mW/cm^2 and 1 mW/cm^2 respectively. For any frequency (f) between 3 and 300 MHz, the limit is 900/f^2 mW/cm^2. The FDA recommends that RF survey meters should be located 10 cm from the operator's surface closest to the RF device. Measurements should be made at the face, chest, gonads, thighs, knees, shins and feet, with the operator in the normal operating position.

For a copy of the FDA guidelines, contact Dr. Zory Glaser or Howard Bassen at the Center for Devices and Radiological Health, FDA, Rockville, MD 20857, (301) 443-7155 or 443-6536.

ANS C63 and NEMA on EMC

American National Standards Committee C63 on Electromagnetic Compatibility (EMC) met in Washington, DC, on May 24. Among the developments at the meeting:

- The committee approved a move by subcommittee 1 to begin work on a recommended practice on configurations for electromagnetic interference (EMI) testing procedures, with special emphasis on the placement of cables. Glen Dash, of Dash, Straus & Goodhue in Boxboro, MA, is the chairman of the task group set up for this new effort. C63 Chairman Ralph Showers asked Dash to report back on a proposed work plan at the next committee meeting. It was pointed out that cable placement is also under study by CISPR.

- The Naval Electronic Systems Command (NAVALEX) has circulated a proposed *EMC Standardization Program Plan*, covering some 25 Department of Defense documents: 6 are presently being revised and 7 are in preparation. The program plan lists their current status. For more information, contact David Perkins, Standardization Branch, NAVALEX, Washington, DC 20363.

- A question arose as to what policies C63 should recommend for the measurement of transients. A task group was set up within subcommittee 1 to consider this question. Ed Bronaugh of Electro-Metrics, Glen Dash, Don Heirman of AT&T Information Systems Labs and Ralph Showers of the University of Pennsylvania will serve on the ad hoc group. (See also Standards Update on p.10.)

- A letter from Joseph Charyk, chairman of the National Security Telecommunications Advisory Committee, requesting assistance in the development of standards to protect the "U.S. Telecommunications Infrastructure" from disruption by an electromagnetic pulse (EMP) was circulated at the meeting. Showers will write back expressing interest in helping develop instrumentation to measure EMPs, but leaving open the question of developing protection techniques.

- Harold Gauper, vice-chairman of the C63 committee, announced that he will be retiring from GE Corporate R&D as of July 31. He said his decision was based in part on GE Corporate R&D's new policy of discontinuing work on EMC. Responsibility for compatibility will now rest solely with those divisions that market specific products. Gauper said that he will do consulting and will continue to work with C63, though not as vice-chairman.

The next meeting of C63 will be held in Washington, DC, on November 15; subcommittee 1 will meet during the August 20-22 meeting of the IEEE EMC Society in Wakefield, MA, and again before the full committee meeting in November.

NEMA

Less than a year ago, the National Electrical Manufacturers Association (NEMA) established a "Coordinating Committee on EMC" to address an emerging concern about EMI. The committee is seeking to identify the possible impact of EMI on the large number of NEMA's prod-

uct areas, to establish liaisons with other EMC standard-setting and coordinating groups and to investigate the problem of power line noise. One of the committee's functions is to channel information among those NEMA divisions responsible for ensuring that specific products do not cause EMI, as well as to keep up with international EMC activities, according to Frank Kitzantides, manager of NEMA's Engineering Department. GE's Harold Gauper is the chairman of the coordinating committee.

Within NEMA's Lighting Division, a "Joint Section Committee on EMI from RF Lighting Devices" has been set up under the chairmanship of Sina Javidi of GE. The committee is sponsoring laboratory research on radiated and conducted electromagnetic interference (EMI) from radiofrequency (RF) lighting devices. In addition, NEMA has installed such devices in its own offices to run experiments on the potential for EMI.

The Lighting Division has two task forces at work: one on measurements, chaired by Ed Marrie of Universal Manufacturing, and one on emission limits, chaired by Ed Morton of North American Phillips Lighting Corp. According to Richard Geissler, NEMA's Manager of Marketing Development and executive of the lighting division, the two task groups hope to complete draft reports by early next year. These documents will be forwarded to the Federal Communications Commission, which has rulemaking pending on RF lighting devices (see *MWN*, September 1983).

BOOK REVIEWS

W. Ross Adey and Albert F. Lawrence, editors, **Nonlinear Electrodynamics in Biological Systems,** New York, NY: Plenum Press, 1984, 603 pp., $89.50.

In June 1983, an international group of experts assembled in Loma Linda, CA, to discuss possible modes of interaction between electromagnetic radiation and living systems (see *MWN*, July/August 1983). The proceedings have been edited by the conference organizers, Dr. Adey of the VA Hospital in Loma Linda and Dr. Lawrence of Hughes Aircraft Co. in Carlsbad, CA. Among the authors of the 38 papers collected in this volume are the leading researchers interested in non-thermal effects. Adey, Davis, Frohlich, Keilman, Kremer, Pohl, Rein, Scott, Swicord and Webb are all represented. Solitons and chaos theory are much discussed — often in quite technical terms.

Robert O. Becker and Robert Selden, **The Body Electric: Electromagnetism and the Foundation of Life,** New York, NY: William Morrow and Co., 1985, 364 pp., $17.95.

Dr. Becker, an orthopedic surgeon best known for his pioneering work on limb regeneration in salamanders, is a leading proponent of the basic role electromagnetism plays in biological systems. Formerly with the VA Hospital and the Upstate Medical Center in Syracuse, NY, Becker has geared his new book toward a lay audience. It is a clearly written, well-illustrated primer that explores Becker's hypothesis that the emerging scientific understanding of the electromagnetic nature of living systems will lead to a revolution in biology and medicine. Becker and his coauthor also discuss the public issues raised by the proliferation of electromagnetic technology. Becker includes a postscript on the opposition to his research in the late 1970's, which eventually led him to retire.

P.N. Cheremisinoff, O.G. Farah and R.P. Ouellette, editors, **Radio Frequency/Radiation and Plasma Processing,** Lancaster, PA: Technomic Publishing Company, Inc., 1985, 213 pp., $45.00.

Focusing on manufacturing applications, the editors present 17 articles on topics ranging from RF drying systems to infrared (IR) uses in France to plasma arc heaters. Based on papers first presented at the International Conference on Electrotechnologies in Industry held in Montreal, Canada, in 1982, this collection emphasizes the cost savings, the improved product quality, the benefits to worker safety and the decreased environmental impacts of these technologies compared to standard ones. Several reports assess research and development efforts and predict future applications.

Vilas D. Nene, **Advanced Propulsion Systems for Urban Rail Vehicles,** Englewood Cliffs, NJ: Prentice-Hall, Inc., 1985, 228 pp., $39.95.

The bulk of this book addresses the electromagnetic compatibility and interference (EMC-EMI) problems generated by chopper-controlled DC and inverter-controlled AC drives used in mass transit vehicles. Of special concern are possible EMI to wayside signaling and communications systems, as well as to automatic train control equipment, and to a lesser extent, EMI to adjacent telephone, radio and TV circuits. The book closes with a number of case studies of EMC in transit systems in the U.S. and Japan.

Nicholas H. Steneck, **The Microwave Debate,** Cambridge, MA: MIT Press, 1984, 279 pp., $25.00.

Steneck, a historian at the University of Michigan in Ann Arbor, recounts the evolution of scientific understanding of the biological effects of radiofrequency and microwave radiation and the development of safety standards — both the 1966 ANSI 10 mW/cm^2 guidelines and their revision in 1982. Along the way he covers a number of controversial episodes, including the thermal versus non-thermal debate, RCA's and HBO's attempts at siting satellite stations, the Moscow embassy affair and the Yannon case. Steneck delves into the specifics of some of the best known bioeffects imbroglios: Zaret's cataract hypothesis, Frey's finding of leakage through the blood brain barrier and the Guy-Air Force long-term, low-level study. Steneck argues that "politics and science have become intertwined in the microwave debate."

UPDATES

BIOLOGICAL EFFECTS

Electric Field Exposure...A research team from the Central Electricity Generating Board, the Central Electricity Research Labs and the University of Oxford in the U.K. has found "no significant correlations of health [among workers] with either measured or estimated exposure to electric fields." The results are based on questionnaires and exposure assessments of 390 electrical power transmission and distribution workers exposed to 50 Hz electric fields. Among the findings was the "striking" low level of exposures: only 28 were exposed to more than 6.6 kV/m.hr over the two-week measurement period — the largest was 242.6 kV/m.hr. (Note that measured and estimated exposures did not correlate well with each other.) The authors caution that the electric fields may have an effect on health other than on those indices studied, that larger electric fields might have an effect or that certain vulnerable individuals may be at greater risk. "Health of Workers Exposed to Electric Fields" by D.E. Broadbent et al. appears in the *British Journal of Industrial Medicine, 42,* 75-84, 1985.

Guy Cancer Data Released... The tumor data from the long-term study at the University of Washington, Seattle, on the effects of low levels of pulsed microwaves have been released by the U.S. Air Force (see *MWN,* July/August 1984 and March 1985). Dr. Bill Guy and coworkers report that:

> The incidence of neoplastic lesions corresponds to that reported for this strain of rat [Sprague-Dawley]....The endocrine system had the highest incidence of neoplasia in the aging rats, as is to be expected in this experimental animal. The low incidence of neoplasia with no increase in any specific organ or tissue required the data to be collapsed and statistically evaluated with respect only to occurrence of the neoplasm, with no attention given to the area of occurrence. This analysis indicated that neither group had an excess of benign lesions. There is statistical evidence that the mean number of primary malignancies was higher in the exposed animals than in the sham exposed, but the biological significance of this difference is reduced by several factors. First, detection of this difference required the collapsing of sparse data without regard for the specific type of malignancy or tissue of origin. Also, when the incidence of the specific primary malignancies in the exposed animals is compared with specific tumor incidence reported in the literature, our exposed animals had an incidence similar to that of untreated control rats of the same strain, maintained under similar [specific-pathogen-free] conditions. It is important to note that no single type of primary malignancy was enhanced in the exposed animals. From the standpoint of carcinogenesis, benign neoplasms have considerable significance under the assumption that the initiation process is similar for both benign and malignant tumors. The fact that treatment groups showed no difference in benign tumor incidence is an important element in defining the promotion and induction potential of microwave radiation for carcinogenesis. The collapsing of sparse data without regard for tissue origin is useful in detecting possible statistical trends, and the finding here of excess primary malignancies in the exposed animals is provocative; however, when this single finding is considered in the light of other parameters evaluated, it is questionable if the statistical difference reflects a true biological activity. No meaningful statistical analysis could be made of metastatic neoplasms because of their low incidence.

The total number of tumors identified by Guy was: 18 primary malignancies, 36 metastatic malignancies and 62 benign for the exposed rats. For the control animals, the tumor totals were: 5 primary malignancies, 18 metastatic malignancies and 53 benign. The Guy team also note that "there is some indication that the survival times are longer in the exposed animals." *Volume 8: Evaluation of Longevity, Cause of Death and Histopathological Findings* is available from Dr. Jerome Krupp, USAF School of Aerospace Medicine, Brooks AFB, TX 78235. The final, summary volume (No.9) is still in preparation.

COMMUNICATIONS

More Teleports... The number of teleports in the U.S. will rise to 200 by 1995, although only 18 are currently operating, according to a new report from Frost & Sullivan, an international market research firm. "The Market for Teleports in the United States: 1985-1994" (Report No.1388, February 1985) projects total expenditures over the next decade of $1.5 billion (in constant 1985 dollars), including $400 million spent on microwave links for the communications centers during that period. Another $100 million will be invested in fiber optics. To meet the steadily growing need for affordable satellite communications, the average 1995 teleport will use 25 earth station antennas, 50 microwave links and 10 miles of fiber optic cables. The report is available for $1,700 from Frost & Sullivan, Inc., 106 Fulton St., New York, NY 10038, (212) 233-1080.

COMPATIBILITY & INTERFERENCE

ELF EMI to Pacemakers... Some unipolar pacemakers are sensitive to high intensity 60 Hz electric fields, according to a study for EPRI by Drs. A.J. Moss and E. Carstensen of the University of Rochester. The researchers exposed 11 patients with seven different implanted pacemakers from 4 manufacturers to 2-9 kV/m electric fields, with total body currents of 47-175 uA. Only unipolar units made by Cordis (models 190A and 190F) and Cardiac Pacemakers (model 505) were susceptible to EMI; the types of transient alterations detected were: inappropriate triggered activity, inhibition of impulse generation, reduction in rate and reversion from demand to asynchronous mode. The authors note that the interference-causing fields can be encountered under 500 and 765 kV power lines, but add that new circuit designs can eliminate the potential for EMI. *Evaluation of the Effects of Electric Fields on Implanted*

Cardiac Pacemakers (EPRI EA-3917, February 1985) is available for $11.50 from Research Reports Center, PO Box 50490, Palo Alto, CA 94303, (415) 965-4081. (See also *MWN*, June 1984.)

UHF RFI... The National Association of Broadcasters (NAB) and the Association of Maximum Service Telecasters (AMST) have asked the FCC to set up a government-industry committee to "study the issue of interference to UHF television signals by land mobile licensees operating in the UHF spectrum." In an April 26 letter to FCC Chairman Mark Fowler, NAB President Edward Fritts and AMST President Tom Paro recommended that laboratory and, if necessary, field testing should be done under the auspices of the FCC. They also urged that this committee should complete its work within eight months of its formation.

Other Developments... At the last meeting of the RTCA Special Committee 156 on potential EMI to aircraft electronics from computers and the like, held April 23-24, a question was raised as to whether shielding of aircraft windows might increase path loss and thus reduce the risk of interference. This and other issues will be discussed at the committee's next session, July 23-24. (See also *MWN*, September 1984.)...Non-striking pilots for United Airlines reported numerous cases of radio communications "jamming" by pilots from other airlines during the United strike. A spokesman for the FAA explained that unionized pilots were "keying" their microphones when United pilots attempted to talk to air traffic control. The FAA's Administrator for Air Traffic, Donald Engen, warned both United and the Air Line Pilots Association in telegrams, sent on May 20th, that the agency would prosecute violators, but an FAA staffer admitted that with several pilots using a frequency at any given time it is "very hard" to catch violators....Static electricity caused the fatal fire on January 11 at a Pershing II nuclear missile site in West Germany, U.S. Army experts have concluded. A two-month investigation found that a static charge sparked the missile's solid fuel propellant, killing 3 servicemen and injuring 16 others. The accident will prompt better grounding of Pershing engines, according to Army officials....Stray electrical currents below New York City's Central Park may be corroding metal pipes in the refrigeration system of the park's ice skating rink, which is under renovation. The currents, which some experts believe come from underground cables or the subways, are common in the city, according to a consultant hired to remedy the problem. The *New York Times* reported on May 22nd that it could cost the city $2 million to repair the damage.

MEDICAL APPLICATIONS

Resources... The safety of NMR imaging is the subject of an editorial in the April 20 *Lancet* — which prompted two interesting replies in the British journal's May 11 issue. A detailed review of NMR safety will appear in a forthcoming issue of *Microwave News*....Also in the May 11 *Lancet*, Dr. A.T. Barker and coworkers at Sheffield University in the U.K. report on a non-invasive method of stimulating the human motor cortex with a pulsed magnetic field....The FDA's Center for Devices and Radiological Health has published *Therapeutic Microwave and Shortwave Diathermy: A Review of Thermal Effectiveness, Safe Use and State of the Art: 1984* (No. FDA 85-8237). It is available for $2.25 from the Government Printing Office, Washington, DC 20420. Order No. 017-015-00226-8....The June issue of *IEEE Spectrum* features an article on "The Friendly Uses of RF." Robert Shupe and Ned Hornback of the Indiana University School of Medicine review the use of PEMFs to heal fractures and of RF energy for hyperthermia....New from Professor C.A.L. Bassett: with M.H.M. Harrison, "Use of Pulsed Electromagnetic Fields in Perthes Disease: Report of a Pilot Study," in *Journal of Pediatric Orthopedics, 4*, 579-584, 1984; and with James S. Kort, "Role of Electricity in the Treatment of Congenital Pseudoarthrosis of the Tibia," in *Reconstruction Surgery and Traumatology, 19*, 140-146, 1985.

MEETINGS

Power Line Review... The annual review of research on the bioeffects of electric and magnetic fields associated with high voltage power lines has been tentatively scheduled for the week of November 4 in Washington, DC. Like last year, contractors for EPRI and the New York State Power Line Project are expected to join DOE researchers. The schedule will be finalized over the summer. For more information, contact Dr. William Wisecup, Aerospace Corp., Suite 4000, 955 L'Enfant Plaza, SW, Washington, DC 20024, (202) 488-6000.

DNA Workshop...ONR sponsored a *Workshop to Review Research on Biological Effects of High Frequency Electromagnetic Fields* in Asilomar, CA, April 28-30. 25 scientists were invited to discuss theoretical (vibrational, electronic and cooperative responses) and experimental (effects on DNA) topics. One of the primary objectives of the meeting was to help the ONR and the FDA set future funding priorities. No proceedings are being prepared.

PEOPLE

New Head of EEPA... The Electromagnetic Energy Policy Alliance (EEPA), the trade association of manufacturers and users of non-ionizing radiation systems, elected Barry Umansky as its new president on May 17 at EEPA's annual meeting in San Diego, CA. Umansky, who is the deputy general counsel for the National Association of Broadcasters (NAB), replaces Daniel Walters, a vice president of

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MCI Telecommunications Corp. Corporate members of EEPA include: AT&T Bell Labs, CBS, GTE, IBM, MCI, Motorola, NAB, NBC, Raytheon, RCA and Rockwell International.

RADAR

Phased Arrays... The new generation of electronically steered radars called "phased arrays" is much in the news. The most famous — or perhaps infamous — unit is the one under construction near Krasnoyarsk and Abalakova in central Siberia. U.S. officials believe that the Soviet radar violates the SALT I accords, though there is still an ongoing debate on the significance of the violation. Under SALT I, phased array radars must be built along Soviet Union or U.S. borders. In the U.S. the Air Force has two PAVE PAWS radars in operation: one on the east coast at Otis Air Guard Base on Cape Cod in Massachusetts and one on the west coast at Beale Air Force Base in California. Are the Soviets up to something sinister or is there another explanation for building the radar 600 miles from the nearest frontier? R. Jeffrey Smith outlines both sides of the argument in the March 22 *Science* magazine. The Soviets contend that the radar doubles as a way of tracking objects in space, which is allowed under SALT I — indeed, the U.S. PAVE PAWS radars also perform this function. Some analysts contend that the Soviets picked the internal site as an economy move (saving them from having to build two radars) or for topographic and climatic considerations (for instance, the harsh frigid winters that would make maintenance a nightmare). On March 9, syndicated columnist Jack Anderson offered another possibility: the late Konstantin Chernenko grew up in Siberia and may have used his political influence to put the radar there in the age-old tradition of pork barrel politics. On April 16, *The Washington Post* reported that the Americans and Soviets are beginning to soften their positions that the Soviets are violating SALT I. The *Post* cites a new U.S. intelligence consensus that the Krasnoyarsk radar is an early warning radar — built primarily to spot submarine-launched missiles from the northern Pacific. One possible solution to the disagreement is that the Soviets could limit the radar's angle of coverage. For a discussion of the impact of phased array radars on the ABM treaty, see "U.S., Soviet Programs Threaten ABM Treaty" in the April issue of the *Bulletin of the Atomic Scientists*....Meanwhile, the U.S. is continuing to add new phased array radars to its early warning system. The third PAVE PAWS radar is nearing completion at Robins Air Force Base in Georgia, and late last year ground was broken on the fourth PAVE PAWS installation in Eldorado, TX, near Goodfellow Air Force Base. The Air Force also expects a new phased array radar to be operational in Thule, Greenland, in the fall of 1986....The U.S. also uses a phased array radar, called Cobra Judy, at sea. According to the January 1985 *Defense Electronics,* the Air Force is in the process of adding an X-band radar, which will stand five stories tall, to the USNS Observation Island. It will complement the ship's existing S-band phased array unit....To learn how a phased array radar works, see Eli Brookner's extremely readable article in *Scientific American* (the February issue's cover story). Brookner, who is with Raytheon, which is building the PAVE PAWS units for the Air Force, explains how the electronically steered radar can yield information on the location, bearing, velocity and even the length of a target. He describes how the new generation of gallium arsenide technology will encourage the development of smaller phased array radars: a few monolithic microwave ICs will replace hundreds of parts. He predicts that NASA will soon send a phased array radar into space for surveillance and mapping duties....Such radars are already being used for research on ionospheric phenomena. A group from Johns Hopkins University's Applied Physics Lab describes the phased array backscatter radar in operation at Goose Bay, Labrador, Canada, in the January-February 1985 issue of *Radio Science*....On October 15-18, many of the technical issues related to these radars will be addressed at *Phased Arrays '85* in Bedford, MA. For more information, contact Dr. Hans Steyskal, RADC/EEA, Hanscom AFB, MA 01731, (617) 861-2052....Phased arrays are also being used in the treatment of cancer. *The IEEE Transactions on Microwave Theory and Techniques* is planning to publish a special issue in May 1986 on the use of phased arrays for hyperthermia. For more information, contact Professor James Lin, Department of Bioengineering, University of Illinois at Chicago, Box 4348, Chicago, IL 60680, (312) 996-2331.

STANDARDS

Blasting Caps and Medical Surveillance...ANSI C95's Subcommittee V has drafted a new standard, *Safe Distances from Radiofrequency Transmitting Antennas for Electric Blasting Operations*. Members of C95 have until June 28 to cast their ballots on the draft standard, which was developed under the aegis of Subcommittee V Chairman Ramie Thompson. Based on the possibility that the wires of an electric blasting cap can act as a receiving antenna for RF energy, the proposal discusses procedures to minimize the risk of accidental detonation....An ad hoc committee of C95 has been studying the merits of developing a surveillance program for workers exposed to RF/MW radiation. Dr. Charlotte Silverman of the FDA, the chairwoman of the ad hoc group, reports that such a program "is needed and is feasible." The group has prepared a report that will be discussed, among other matters, at the committee's next meeting on June 20, immediately following the BEMS conference in San Francisco.

IEC on Measuring Transients... The IEC's Technical Committee No.77 on EMC between electrical equipment has released a *Guide on Methods of Measurement of Short Duration Transients on Low Voltage Power and Signal Lines*. Publication 816 describes the effects of such transients, caused primarily by lightning or electrical switches, and explains how to determine which parameters should be measured to characterize them. The well-illustrated report, printed in English and French, is available for $62.00 plus postage from ANSI's International Sales Dept., 1430 Broadway, New York, NY 10018.

TECHNOLOGY

Pulsed Power... William Weldon of the University of Texas at Austin reviews the technology required to generate pulsed power for electromagnetic launchers, EMP simulators, fusion research and lasers in the March issue of *IEEE Spectrum*....The NBS is planning a *Workshop on Measurement of Electrical Quantities in Pulse Power Systems,* to be held in Gaithersburg, MD, March 5-7, 1986. Among the topics to be covered are the measurement of voltage, current and power, as well as calibration methods. The attendance fee has yet to be set but is expected to be less than $100. Contact: Ron McKnight, B344 Metrology Bldg., NBS, Gaithersburg, MD 20899, (301) 921-3121....The Army Electronics R&D Command is setting up a Pulse Power Center at Fort Monmouth, NJ. Contact: Joseph O'Connell at Fort Monmouth's Low-Energy Pulsers Team Electronics Technology and Devices Lab, (201) 544-5404....The *5th IEEE Pulsed Power Conference* will be held in Arlington, VA, this June 10-12. Contact: Dr. Frank Rose, Naval Surface Weapons Center, F-04, Dahlgren, VA 22448, (703) 663-8026.

VDTs

Swedish Research Review...A researcher with Sweden's National Board of Occupational Safety and Health (NBOSH) has published an 87-page review, *Video Display Terminals and Health: A Technical and Medical Appraisal of the State of the Art.* It assesses the risks faced by workers for a wide range of reported ailments, including stress, reproductive abnormalities, visual and ocular damage and musculoskeletal problems. In the report's summary, author Ulf Bergqvist and his NBOSH colleague Bengt Knave conclude that "VDT/CRT units do not cause birth defects or spontaneous abortions." In addition, they dismiss reported similarities between VLF radiation emissions from VDTs and the fields used by the Delgado team on chick embryos (see *MWN,* September 1984). Single copies of the report, which appeared originally in the *Scandinavian Journal of Work, Environment & Health, 10,* Supplement 2, 1984, are available for 130 Swedish Kronor each (about $14.50), prepaid, from Bergqvist, NBOSH, S-171 84 Solna, Sweden (make checks payable to "WWDU").

FROM THE FIELD

IBM on Guy's VDT Report

To The Editor:

Your recent *Microwave News* story misinterprets a report prepared for IBM by Dr. A.W. Guy (*MWN,* April 1985). Your story is inaccurate and grossly misleading.

This is especially distressing since IBM provided you in advance with additional clarifying information. You also had Dr. Guy's report summary which states there is "no valid evidence that would indicate any health hazards associated with...persons operating VDTs."

Dr. Guy since has added a preface to his full report which states "VDTs are safe to use." He adds that the emissions from "both older and newer model VDTs are well below the levels shown to cause harmful biological effects."

Here, again, are the facts:

- No place in the report or summary does Dr. Guy recommend refitting older VDTs with shielding because of possible health problems. Dr. Guy reconfirms this in his preface by saying: "I do not feel...that unshielded VDT emission levels represent a potential health hazard."
- Dr. Guy does observe that there is a *perceived* problem based on *unverified* reports. In his preface, Dr. Guy explains that current shielding is desirable because it reassures individuals concerned by those reports, not because he has any health or safety concerns [emphasis in original].
- IBM has not kept Dr. Guy's findings confidential. In accordance with standard scientific practices, Dr. Guy has been reporting his findings at appropriate scientific forums and he will continue to do so. Also, Dr. Guy's summary has been available since September and the full report is available now.
- Dr. Guy's basic conclusion is that VDTs are *safe* and present *no* health hazards to users.

Robert J. Siegel, Director of Information,
IBM, Armonk, New York 10504

We strongly dispute IBM's contention that our story is inaccurate and misleading. We offered no judgment on the question of VDT safety. We simply reported what we consider to be a clear recommendation by Guy for shielding VDTs which do not meet the 1983 electromagnetic interference (EMI) rules set by the Federal Communications Commission.

Referring to older model VDTs in a section titled "Recommendations" *on page 56 of his report to IBM, Guy states: "The localized E-fields at the surface of an unshielded cover of a VDT nearest the flyback transformer can reach extremely high values as a result of the associated high voltage and close proximity of the transformer to the cover. Since these fields have a capability of inducing much greater currents in an exposed user of the device than the relatively low magnetic field emissions,* it certainly is desirable to shield the cover of the VDT" [*emphasis added*]. *We regret that IBM does not address this recommendation in its letter.*

Indeed, to avoid any possibility of misrepresenting Guy's advice to IBM, Microwave News *reprinted the* full text *of his recommendations. We refer interested readers to page 11 of our April issue.*

On receiving IBM's letter, we contacted Guy at the University of Washington in Seattle, but he refused to comment on either our story or Siegel's letter.

Guy's new preface, cited by IBM, is dated April 18; the original report is dated December 2. (By April 18, our April issue was already on its way to our subscribers.) While the preface may help everyone better understand Dr. Guy's position, in no way does it alter the contents of the report itself.

Last fall, when Microwave News *first learned that Dr. Guy was preparing a report for IBM, we repeatedly asked for a copy. We were told that it was for internal use only. Later, IBM released a six-page report summary that did not include Guy's recommendations. Only after we published our story did IBM finally release the full report.*

We stand by our story. – The Editors

CLASSIFIEDS

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CONFERENCES

July 14-19: **1985 Summer Meeting of the IEEE Power Engineering Society,** Hotel Vancouver, Vancouver, BC, Canada. Contact: PES Special Activities, IEEE, 345 East 47th St., New York, NY 10017, (212) 705-7895.

July 22-24: **22nd Annual Conference on Nuclear and Space Radiation Effects,** followed by July 25-26: **1985 Hardened Electronics and Radiation Technology (HEART) Conference,** Monterey, CA. Contact: K.F. Galloway, Div. 726, NBS, Gaithersburg, MD 20899, (301) 921-3541.

July 22-25: **1985 International Symposium on Microwave Technology in Industrial Development —Brazil,** Campinas, Brazil. Contact: Attilio Jose Giarola, SBMO Symposium Committee, UNICAMP-CCPG (Reitoria), CP 1170, 13100 Campinas, SP, Brazil.

August 11-16: **14th International Conference on Medical and Biological Engineering and 7th International Conference on Medical Physics,** Espoo, Finland. Contact: Congress Office, PO Box 105, SF-00251 Helsinki, Finland.

August 19-21: **10th Annual Conference of the Australian Radiation Protection Society,** Melbourne, Australia. Contact: Dr. T.H. Gan, Australian Radiation Lab, Lower Plenty Rd., Yallambie, Victoria 3085, Australia.

August 19-23: **5th Annual Meeting of the Society of Magnetic Resonance in Medicine,** London, UK. Contact: Institution of Electrical Engineers (IEE), Savoy Place, London WC2R 0BL, UK, (01) 240-1871.

August 20-22: **1985 IEEE International Symposium on Electromagnetic Compatibility,** Hilton at Colonial, Wakefield, MA. Contact: Dr. Chester Smith, PO Box 536, Bedford, MA 01730, (617) 271-7086.

August 20-22: **International Symposium on Antennas and Propagation,** International Conference Hall, Kyoto, Japan. Contact: Professor Kazuaki Takao, Dept. of Electrical Engineering, Kyoto University, Kyoto 606, Japan.

August 26-28: **20th Annual Microwave Power Symposium,** Hotel Continental, Chicago, IL. Contact: International Microwave Power Institute, Tower Suite 520, 301 Maple Ave. West, Vienna, VA 22180, (703) 281-1515.

August 26-28: **1985 International Symposium on Antennas and EM Theory,** Beijing, China. Contact: Professor Mao Yukuan, Northwest Telecommunications Engineering Institute, Xi'an, Shaanxi Province, China.

August 26-30: **International Conference on Magnetism 1985,** San Francisco, CA. Contact: Diane Suiters, Suite 300, 655 15th St., NW, Washington, DC 20005.

September 9-12: **15th European Microwave Conference,** Paris, France. Contact: Microwave Exhibitions & Publishers Ltd., Convex House, 43 Dudley Rd., Tunbridge Wells, Kent TN1 1LE, UK.

September 10-12: **7th Annual Electrical Overstress/Electrostatic Discharge Symposium,** Radisson South Hotel, Minneapolis, MN. Contact: Michael Martin, 3M/Static Control Div., 2111 W. Braker Lane, Bldg. 501, PO Box 2963, Austin, TX 78769, (512) 834-3117.

September 12-14: **1st Annual Clinical Hyperthermia Symposium and Workshop,** St. Louis, MO. Contact: Dr. B. Emami, Division of Radiation Oncology, Mallinckrodt Institute of Radiology, 4511 Forest Park Blvd., St. Louis, MO 63108, (314) 362-3470.

September 23-26: **4th International Conference on AC & DC Power Transmission,** London, UK. Contact: IEE, see August 19 above.

September 27-30: **7th Annual Conference of the IEEE Engineering in Medicine and Biology Society,** Americana Congress Hotel, Chicago, IL. Contact: Dr. Barry Feinberg, Kendall Co., 411 Lake Zurich Rd., Barrington, IL 60010, (312) 381-0370. Followed by September 30-October 2: **38th Annual Conference on Engineering in Medicine and Biology,** Chicago, IL. Contact: Susan Leone, ACEMB, 4405 East-West Hwy., Suite 402, Bethesda, MD 20814, (301) 657-4142.