MW & ELF Chronic Studies

Reports of US studies of long-term, low-level exposures, presented at BEMS, indicate a failure to identify any significant bioeffects, though a Chinese study did turn up some microwave-induced changes:

• John D'Andrea reported that his team at the University of Utah had found no differences between 14 rats exposed to 500 uW/cm², 2450 MHz, CW microwaves for 650 hours over 92 days and controls (SAR = 0.12 W/Kg). Indicators of body weight, blood chemistry and open field behavior were all negative. D'Andrea did see a change in a shuttlebox behavioral test, but interpreted it as anomalous. The experiment was designed to extend the work of USSR's Michael Shandala and Battelle's Richard Lovely, both of whom did find some chronic effects. Professor D'Andrea speculated that the apparent inconsistency in results might be explained by differences in the exposure system and in the animals irradiated.

• Members of A.W. Guy's group at the University of Washington, Seattle, presented a progress report on their million dollar, three year study. At the end of the first year, 100 male rats, exposed to 480 uW/cm², 2450 MHz, 8 Hz modulated, pulsed (800 pps, 10 usec), microwaves had similar body weight, blood chemistry and open field behavior as the 100 controls (SAR equal to or less than 0.4 W/Kg).

• Kuo-Chiang Yee of the Microwave Institute of Chekiang Medical College, now visiting Guy's lab, reported finding some changes in EEG, EKG and leukocyte counts as well as fluctuations in blood pressure and errors in labyrinth tests among rats and rabbits following six-hour daily exposure for four and a half months to 2450 MHz, CW fields at power levels ranging from 0.1 to 10 mW/cm². No changes in rectal temperature, body weight and whole blood cholinestrase were found. Yee warned that the results of the chronic experiment suffered from exposure conditions that allowed variations in SAR's among the exposed animals, and from the use of metal electrodes to measure EEGs and EKGs.

• James Grissett of the Naval Aerospace Research Lab in Pensacola, FL, described the replication of the long-term study of rhesus monkeys exposed to ELF fields of 0.2 mT and 20 V/m, which had showed a difference in growth rate of males, but not females, during the first year followed by no further changes. After completing its first year, the replication study has failed to show any differences in growth and development, leading Dr. Grissett to conclude that the ELF electric and magnetic fields "did not have a generalized metabolic effect on rhesus monkeys."

New Meters

Tadeusz Babij and Howard Bassen described a new RF meter developed at the Bureau of Radiological Health as a low cost alternative to today's $2,000-3,000 instruments. The unit, operating in the 10-100 MHz range with a projected price of about $1,000, should be attractive to local health officials for monitoring in occupational settings such as RF sealer operations. The bureau is demonstrating the meter to the private sector and is negotiating with a few companies that have expressed an interest in manufacturing it.

Scientists at the Lawrence Berkeley Lab are developing a portable magnetic field dosimeter. The second generation prototype, according to Dr. T.S. Tenforde, responds to steady-state and time-varying fields of up to 5,000 gauss. The unit has a memory capable of recording exposures over an 8-hour shift, as well as an alarm, triggered at preset levels of maximum magnetic fields and their rate of change. The unit weighs about a pound and would cost $300-500 if 100 units were produced. Tenforde and his colleagues are now working on a third stage prototype. (Possible magnetic field exposure standards were discussed by Dr. C.E. Easterly of the Oak Ridge National Lab.)

Living Magnets

Professor Richard Frankel of MIT's National Magnetic Lab gave an impromptu talk on animal magnetism, a new field that promises to attract growing attention. With the discovery of magnetic bacteria, scientists have widened the search for living creatures that can manufacture their own magnetic material: so far, pigeons, honey bees, butterflies and sharks have all been found to contain small quantities of magnetite. (A report in the August 21 *Science* adds dolphins to this list.) Frankel left his audience with the intriguing suggestion that such living magnets may interact with radiant energy in as yet unpredictable ways.

Radiophone Radiation

With the promised growth of radiophones for mobile communications, many more cars will be sporting UHF antennas, raising interest about this new source of radiation exposure. Professors Guy and C.K. Chou have made some measurements with full scale human phantoms, standing and leaning on a 1971 Mazda. For an input power of 10 watts, they found a maximum SAR for a leaning woman of 0.6 W/Kg near the bridge of the nose. This was only a feasibility study using homogeneous models; now they plan to add detail to the models and take more measurements.

Project Migraine

Can a human "hear" signals of an impending earthquake or volcanic eruption? A woman from Salem, OR, seems to be able to. According to Christopher Dodge of the Congressional Research Service, she has a good record for predicting seismic activity, and she was found to be in sync with meters on Mt. St. Helens during last year's eruptions. The woman, who suffers from headaches and hence the name of the study she has spawned, Project Migraine, is currently undergoing tests at the University of Colorado. These hope to uncover any possible coupling between the woman and geophysical systems; while electromagnetic coupling has not been ruled out, an auditory effect is deemed more likely. Dodge guessed that there may be as many as 1,000 people across the country with the same condition. If anything comes of this, they may be in great demand.

•

At its annual business meeting, the election of Dr. Donald McRee of the National Institute of Environmental Health Sciences as president-elect of BEMS was announced. Next year's meeting will be held at the Beverly Wilshire Hotel in Los Angeles the week before the July 4th weekend.

STANDARDS

ACGIH

The American Conference of Governmental Industrial Hygienists (ACGIH) has proposed a new threshold limit value (TLV) for radiofrequency radiation and a revision of its microwave radiation TLV standard.

The ACGIH proposal has the same "well" shape as the NIOSH and ANSI proposals—the precise shape of the well is different for each—but is less stringent at the higher GHz frequencies. At the bottom of the well between 30 and 100 MHz, the proposed TLV is 1 mW/cm², rising at lower frequencies to 100 mW/cm² at 3 MHz and at higher frequencies to 10 mW/cm² at 1 GHz. (See opposite page for the full text of the ACGIH proposal.) The maximum high frequency power level suggested by either NIOSH or ANSI is 5 mW/cm².

The 100 mW/cm² limit would apply to frequencies as low as 10 kHz, making it the only US standard, either proposed or promulgated, to cover low frequency emissions from VDTs.

There is no current ACGIH TLV for radiation below 300 MHz, and the one for microwaves (300 MHz–300 GHz) is 10 mW/cm². According to the proposed change, the standard would become 3 mW/cm² at 300 MHz, increasing 1 mW/cm² for each 100 MHz rise in frequency up to 1 GHz. Above 1 GHz, the old and the new standards are the same.

The proposal offered by the Physical Agents TLV Committee was approved by the ACGIH board and membership at its annual meeting in Portland, OR, last May. It was recently published in the 1981 edition of the ACGIH TLV booklet in a "Notice of Intended Changes." According to ACGIH procedures, proposals are considered trial limits for at least a year, when they become eligible for formal adoption.

In an interview, Bill Kelly, executive secretary of ACGIH, stressed that the system allows all interested parties to comment on proposed changes. "We want as much input as we can get," he said. The review process is already under way: the TLV committee met in Toronto in mid-August, and some modifications to the low frequency portion of the standard were considered. Another meeting of the committee is scheduled for December.

The committee is also studying the possibility of setting TLVs for extremely low frequency (ELF) radiation (0–300 Hz) and for continuous and pulsed magnetic fields. At present the committee believes there is not enough information to propose standards.

Any comments on the RF/MW proposal should be sent to William Kelly, Executive Secretary, ACGIH, 6500 Glenway Avenue, Bldg. D-5, Cincinnati, OH 45211.

ANSI

A new draft of the American National Standards Institute's (ANSI) C95.1 standard for human exposures to radiofrequency and microwave radiation has been circulated to the C95 committee. Changes in the draft, worked out by Professor A.W. Guy, subcommittee IV chairman, are designed to resolve the objections that have delayed the standard. Committee members have until September 7 to submit comments on the draft. If no objections are raised, the standard will be submitted to ANSI for public review and comment. Otherwise C95 Chairman Professor Saul Rosenthal will call a full committee meeting to decide how to proceed.

The draft now being circulated, however, is essentially the same as the draft considered at the last C95 committee meeting in February. (Full text published in *MWN*, May 1981.)

One change is a rearrangement and rewording of the language on the standard's applicability to the general population:

> "Because of the limitations of the biological effects data base, these guides are offered as upper limits of exposure, particularly for the population at large. Where exposure conditions are not precisely known or controlled, exposure reduction should be accomplished by reliable means to values as low as are reasonably achievable. Exposures slightly in excess of the radiofrequency protection guides are not necessarily harmful; however, they are *not* desirable and should be prevented wherever possible."

The clause that specifies the guides "are not recommendations of levels for exposures of indefinite duration" has been deleted.

Other changes include the addition of a definition of "specific absorption rate" (SAR) and new language to describe the measurement of electromagnetic fields.

In the rationale document that accompanies the standard, a paragraph has been added to clarify how SAR's may be measured in order to qualify for the standard's exclusion clause:

> "It was also recognized by the Subcommittee that to determine whether or not a particular RF source would meet these absorption criteria would be difficult and could be done only by a qualified laboratory or scientific body for a general class of equipment. In no case could a routine field survey determine conformance with the criteria of this part of the exclusion."

USSR

The Soviet Union has indeed raised its occupational standard to 25 uW/cm², according to Guy, who was in Kiev last June, although a senior Russian official attending the URSI meeting could not confirm the change.

Guy said that he had learned of the revision from Dr. B. Savin of Moscow's Institute of Industrial Hygiene and Occupational Diseases. Effective January 1982, the new occupational standard will be 25 uW/cm² for an 8-hour working day, 200 uW/cm² for a 2-hour exposure, and 1 mW/cm² for 20 minutes. The 20-minute standard is the same as the one now in effect, the 8-hour standard is now 10 uW/cm², and the new 2-hour limit is a doubling over the present 100 uW/cm² standard.

Meanwhile Professor Inal Akoev, deputy director of the Institute of Biological Physics in Pushchino, a scientific center south of Moscow, would only say that the standard was under discussion and that a decision on a possible revision may be reached by the end of the year.

Guy, who was visiting the Soviet Union from the University of Washington, Seattle, reported that the standard setting process in the USSR was similar to that in the US—marked by conflicts between regulators and users.

WHO & IRPA

Dr. Przemyslaw Czerski, presently visiting BRH from Poland, reviewed standards in Europe for the URSI conferees.

He announced that the World Health Organization (WHO) had adopted the "ALARA" principle for determining permissible exposures to non-ionizing radiation: "public exposures should be kept as low as readily achievable." Czerski noted that in applying the ALARA principle, WHO advised the consideration of social and economic factors, taking into account local conditions. He quoted from the new WHO report on non-ionizing radiation:

> "Values within the range 0.1–1 mW/cm² include a high enough safety factor to allow continuous exposure to any part of the frequency range over the whole working day. Higher exposures may be permissible over part of the frequency range and for intermittent or occasional exposures."

Czerski reported that Italy and the EEC were also in the process of setting non-ionizing radiation standards. At the IMPI meeting (see p. 7) Amleto Ignesti said that the Instituto Superiore di Sanita in Rome would develop a standard by the fall.

Annette Duchene, secretary of the International Radiation Protection Association's (IRPA) non-ionizing radiation committee, said that the committee was also working on an exposure standard. A detailed report on IRPA's activities will appear in *Microwave News* next month.

ACGIH STANDARD—Full Text

ACGIH NOTICE OF INTENDED CHANGES (1981)

Radiofrequency/Microwave Radiation

These Threshold Limit Values (TLVs) refer to radiofrequency (RF) and microwave radiation in the frequency range from 0.01 MHz to 300 GHz, and represent conditions under which it is believed workers may be repeatedly exposed without adverse health effects. The TLVs shown in the Table are selected to limit the average whole body specific absorption rate (SAR) to 0.4 W/kg in any six minutes (0.1 hr) period for 3 MHz to 300 GHz, see the Figure below..

Since it is usually impractical to measure the SAR, the TLVs are expressed in units that are measurable, viz, squares of the electric and magnetic field strengths, averaged over any 0.1 hour period and this can be expressed in units of equivalent plane wave power density for convenience. The squared electric field (E), magnetic field (H) strength values, and power density (PD) are shown in the Table. For near field exposures PD cannot be measured directly, but equivalent plane wave power density can be calculated from the field strength measurement data as follows:

$$\text{PD in mW/cm}^2 = \frac{E^2}{3700} \qquad \text{where:}$$

E^2 is in volts squared (V^2) per meter squared (m^2).

$$\text{PD in mW/cm}^2 = 37.7\ H^2 \qquad \text{where:}$$

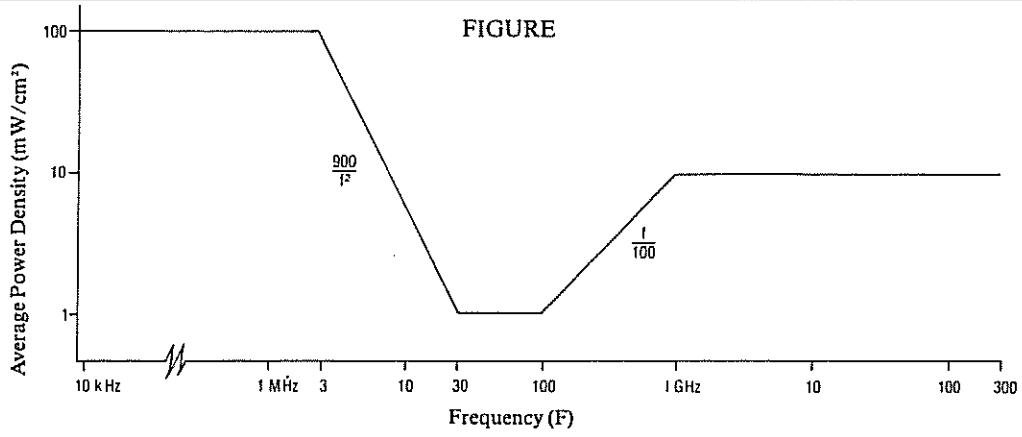
H^2 is in amperes squared (A^2) per meter squared (m^2).

These values should be used as guides in the evaluation and control of exposure to radiofrequency/microwave radiation, and should not be regarded as a fine line between safe and dangerous levels.

Notes:

1. All Radiofrequency Radiation (RFR) exposures should be kept as low as reasonably possible given the current state of knowledge on human effects, particularly non-thermal effects.
2. For fields consisting of a number of frequencies, the fraction of the protection guide incurred within each frequency level should be determined and the sum of all fractions should not exceed unity.
3. For pulsed and continuous wave fields, the power density is averaged over the six minute period, and should not exceed the values in the Table, except as noted for partial body exposure.
4. For partial body exposures at frequencies between 0.01 MHz and 1.0 GHz, the protection guides in the Table may be exceeded if the output power of a radiating device is 7 watts or less. For example, if a hand held transmitter operating at 27 MHz has a maximum output of 5 watts, it would be excluded from any further field measurements.
5. No measurement should be made within 5 cm of any object.
6. All exposures should be limited to a maximum (peak) electric field intensity of 10 kV/m.

FIGURE



Threshold Limit Values (TLV) for Radiofrequency/Microwave Radiation in Workplace (Whole Body SAR Less Than 0.4 W/kg).

TABLE
RADIOFREQUENCY/MICROWAVE THRESHOLD LIMIT VALUES‡

Frequency	Power Density (mW/cm^2)†	Electric Field Strength Squared (V^2/m^2)	Magnetic Field Strength Squared (A^2/m^2)
.0.01 MHz to 3 MHz	100	377,000	2.65
3 MHz to 30 MHz	$900/f^{2*}$	$3770 \times 900/f^{2*}$	$\frac{900}{37.7 \times f^{2*}}$
30 MHz to 100 MHz	1	3770	0.027
100 MHz to 1 GHz	f*/100	3770 x f*/100	f*/37.7 x 100
1 GHz to 300 GHz	10	37,700	0.265

†mW/cm^2 = milliwatts per centimeter squared
*f = frequency in MHz
‡Note that the Table, as originally published in the ACGIH TLV booklet contains two typos, which have been corrected here.

VDTs

NAS SYMPOSIUM

A symposium on Video Display Terminals and Vision of Workers sponsored by the National Academy of Sciences' Committee on Vision drew 250 people to Washington, DC, this August 20-21. Topics for the two day meeting ranged from the physiology of the eye to the design of VDTs.

The session on radiation exposure was the only discussion to end on a note of consensus. Symposium chairman Dr. Edward Rinalducci, of the Georgia Institute of Technology, concluded that the radiation risks "seem not to be considerable." Other potential hazards, however, were harder to define and require further study.

Radiation Surveys

Survey data on VDT radiation emissions were outlined by Bill Murray of the National Institute for Occupational Safety and Health (NIOSH). The very low levels of all emissions, Murray said, have convinced NIOSH that routine checks of VDTs are no longer necessary. Although requests for testing often cite possible malfunctions or variations in VDT models, Murray asserted that there is no reason to believe broken machines leak radiation. Further, NIOSH believes the variations among VDT models produced by some 150 manufacturers are minimal.

The key radiation issue for all concerned is the possible link between cataract development and chronic exposure to VDT radiation. Dr. Martin Mainster, of the Retina Foundation in Boston, said only large epidemiological studies could fully answer this concern, but "we can be reasonably confident from studies and surveys that any risk of specific ocular problems [caused by] VDTs is very unlikely." Professors William Ham, from the Medical College of Virginia, and Donald Pitts, from the University of Houston College of Optometry, agreed with Mainster. As a former member of the Electromagnetic Radiation Management Advisory Council, Ham said he has been concerned about radiofrequency and microwave bioeffects for a long time, "but no one who has studied in this field for the past ten years is the least bit concerned" about VDTs.

Cataracts and Epidemiologies

The focus on cataracts continued into the next panel on ocular pathology. Though not identified by name, the work of Dr. Milton Zaret, a well known New York ophthalmologist who maintains that low levels of non-ionizing radiation cause cataracts, was addressed. Alfred Sommer, of the Wilmer Ophthalmological Institute at Johns Hopkins University, said the ten anecdotal cases of cataracts—reported by Zaret—which are the primary evidence for a VDT-cataract link, are not convincing. Dr. Hugh Taylor, also from the institute, pointed out that cataracts are a general problem and that there was no evidence linking them to VDTs. Unless "something totally unexpected" comes up in the Mount Sinai or Baltimore *Sun* epidemiologies now underway, Taylor believed it is "not worthwhile to do more work with VDTs."

Dr. Arthur Frank, environmental health physician at Mount Sinai Hospital in New York City and director of its VDT epidemiology, and David Eisen, of the Newspaper Guild, were virtually alone in urging more work on long-term, low-level VDT radiation effects. Frank agreed that there is no evidence of damage, but stressed that little research has been done and that more data are needed. Eisen warned against "closing the book" on this issue before the *Sun* and Sinai studies are completed. NIOSH's Murray also called for more research on the effects of chronic radiation exposure on the eye, and for better field survey instruments. His concern, however, was not associated with VDT hazards.

Reporting on the Mount Sinai study, Frank said that participating members from five of the seven Newspaper Guild locals involved in the project will receive ophthalmological examinations.

Rashes Explained?

Two Scandinavian studies linking facial rashes to static electricity generated by terminals were reported by Olov Ostberg, from the Central Organization of Salaried Employees of Sweden. In Norway, work completed by Walter Cato Olsen, of the Christian Michelsen Institute in Bergen, indicates that "rash-prone operators are commonly exposed to extreme electrostatic fields... caused partly by high voltages associated with the display screens and partly by electric charges accumulated by the bodies of the operators." The number of airborne microscopic particles increases in the presence of these fields. Olsen suggested that field-enhanced exposure to these irritants causes the rash, and possibly other health problems such as eye discomfort. Ostberg noted that Norway's proposed VDT regulations advise that static electricity be reduced to the lowest possible level. The Swedish equivalent of NIOSH is also concerned with static electricity and plans an epidemiology on the possible effects of airborne ions on the skin and eyes. Seven hundred operators and 350 controls will participate in the yearlong study.

Visual Fatigue

Visual fatigue proved more difficult to assess than radiation risks. Evidence of VDT-induced strain included a review of studies documenting changes in the eye's "resting focal point" after prolonged VDT work and of a survey showing more eye complaints from operators as their VDT work hours increased. It is still too early to say whether or not these effects signal permanent ocular change.

Investigations into the causes of eye stress have identified several key factors, including display screen characteristics, ambient lighting and VDT design. Work organization and pacing were also cited.

Surprisingly, not all of the symposium's experts thought VDTs entail a unique set of visual demands. Sommer was not convinced that reading from a display screen, for example, required a different effort than some traditional office work. Drs. Tony Adams, from the School of Optometry at the University of California at Berkeley, and Julian Hochberg, from the psychology department at Columbia University, however, strongly disagreed and cited image reflection on the display face, which is known to produce ocular stress, and the special acuity required by stroke-by-stroke reading.

As research and debate continue, national standards for VDT use have emerged to protect workers. Dr. Martin Helander, of the Canyon Research Group in California, provided a concise review and comparison of these ergonomic standards.

Although participants at the symposium agreed that more research is necessary to guarantee optimal VDT working conditions, current knowledge apparently is not fully utilized. For example, Dr. Harry Snyder, from the Department of Industrial Engineering and Operations Research at Virginia Polytechnic Institute, maintained that some good display screens already exist. Most unit designs, however, are based on home TV screens, which Snyder said are not entirely suitable for VDT work. Unfortunately, no one has compiled either an evaluation of available models or a criteria list for selecting terminals.

A summary of the symposium proceedings may appear this fall, but the final publication decision has not been made. For information, contact Key Dismukes at the Committee on Vision, (202) 389-6068.

BRIEFS

- Recognizing the need for greater information exchange, NIOSH has created the Clearing House on Office Worker Health Issues. Its current focus will be on VDTs, but NIOSH's Michael Smith says a range of issues affecting the office environment will eventually be covered. For information, contact Ted Schoenborn, Division of Technical Services, NIOSH, 4676 Columbia Parkway, Cincinnati, OH 45226.
- The August 13 issue of *New Scientist* reports on Norway's proposed safety guidelines for VDTs. The rules address static electricity produced by terminals, which a study by Norway's Christian Michelsen Institute has linked to facial rashes. (See above.)
- Government regulations for VDT radiation were recommended by this year's Newspaper Guild Convention. The July 31 *Guild Reporter* also notes that the guild is completing a handbook on VDT health measures for its locals.

CONFERENCES

IMPI

The International Microwave Power Institute (IMPI) held its annual symposium in Toronto, June 9-11.

The highlight of the meeting was the participation of Zhi-Yuan Shen, of the department of radio electronics engineering at Zhejang University, Hangzhou, in the People's Republic of China. Shen is now visiting the Microwave Research Institute at the Polytechnic Institute of New York. He outlined the use of microwaves in the production of chocolate, dry milk cake, wine, spirits, timber, paper, medicines and magnetic tape. With respect to medical applications, Shen discussed hyperthermia research, but most interesting was the application of microwaves to acupuncture treatments: "Through a needle-type antenna, the microwave power (frequency about 1000 MHz) was transmitted into some acupoints on the body of the animals and human beings. The experiment indicated that the acupuncture curative effects of some illnesses were improved by this method."

Shen also said that there was some work on male birth control being carried out. Experiments on exposing wheat, soybeans and rice to CW and pulsed microwaves indicated that microwave exposure can stimulate variation in the plants, producing beneficial variations, which are inheritable.

In the opening plenary session, Dr. Geoffrey Voss, of the Surgical Medical Research Institute at the University of Alberta, described the biological effects research field as "most exciting," but decried its "remarkably low level of funding." According to Voss's calculations, the field is only getting one millicent per hertz of band width per year. He felt three millicents would be a more appropriate level—though he did not believe that all frequencies should be allocated equal shares of research moneys.

Maria Stuchly, of the Radiation Protection Bureau, Health and Welfare, Canada, presented an overview of a Canada-wide survey on types, number and use of radiofrequency and microwave diathermy devices. She found that the short wave (RF) treatment is used ten times more frequently than microwave diathermy. Stuchly concluded that the data clearly indicated a danger of overexposure to the operator and recommended voluntary guidelines to limit the risk. The survey found operator exposures as high as 315 V/m and 0.5 A/m for air-spaced electrodes used in knee treatments. Stuchly was particularly concerned with the high intensity fields around the cable connecting the applicator to the diathermy console. Electric fields of above 300 V/m may extend up to half a meter from the cables.

Amleto Ignesti, of the Italian National Research Council in Florence, said that while Italy did not have any microwave standards, the council preferred the USSR exposure limit without committing itself to the Soviet regulatory philosophy. On the subject of worker attitudes toward RF sealers, he observed: "In all cases we have come across, the workers of the industry felt very uneasy because of the suspicion of the presence of this possibly harmful polluting agent which cannot be sensed in any way and that can in principle be anywhere."

Ignesti described a new RF hazard meter with a green-yellow-red output display. The patented instrument responds to fields from below 1 MHz to above 100 MHz, with an accuracy of ± 3 dB. Its cost is about $150 in Italy.

IMPI has been having financial difficulties and is in the process of restructuring its membership dues. Next year's meeting is scheduled for July 25-30 in San Diego.

AROUND THE COUNTRY

Risk Meeting

Professor Nicholas Steneck, a historian at the University of Michigan, is organizing a conference on *Cost/Benefit Analysis and the Microwave Bioeffects Field* to be held next November 12-13 in Ann Arbor.

Supported by the National Science Foundation, Steneck has invited a dozen experts to prepare papers for the meeting: the papers will be circulated in advance, leaving most of the conference open for discussion.

Among those now scheduled to prepare papers are: Zory Glaser, Chris Dodge and Mays Swicord (government); Allan Frey, Don Justesen and Rochelle Medici (research scientists); Howard Johnson and John Osepchuk (industry); Richard Alabanese, Sam Koslov and Paul Tyler (military); Scott Denman and Edward Groth (consumer groups). A.W. Guy, Przemyslaw Czerski and representatives from EPA are also expected to attend.

A limited number of seats for the meeting are still available. For more information contact Steneck at the Department of History, 4638 Haven Hall, University of Michigan, Ann Arbor, MI 48109, (313) 763-2230.

Pre-Proposals Due in NY ELF Study

The scientific advisory panel for New York State's Overhead Power Lines Project, investigating the possible health effects of exposure to 60 Hz radiation from high power transmission lines, has selected research areas for funding and is now soliciting pre-proposals. Research areas include:

- Genetic, cytogenetic, teratogenic and reproductive studies.
- Cell and organ culture studies.
- *In vivo* animal physiology and pathophysiology.
- Animal and human neurobiology.
- Animal and human behavior.
- Multidisciplinary human studies with controlled exposure conditions.
- Epidemiology of human populations.
- Other studies relevant to health hazards.

A total of $5 million in contracts is available.

All pre-proposals are due by October 15, 1981. For more information contact Dr. David Carpenter, New York Department of Health, Albany, NY 12201, (518) 474-4170.

Project ELF Rally

Stop Project ELF, a citizens group opposing the Navy's development of a giant underground antenna for communicating with submerged submarines, scheduled a September 4-7 rally at the Clam Lake, WI, ELF test facility. (See *MWN*, May 1981.) Possible biological effects from the extremely low frequency radiation emitted by the antenna are among the group's concerns.

Two of the directors of the project, John Stauber and Jennifer Speicher, were in Washington, DC, in August filing Freedom of Information Act requests with the Navy. They report that the Navy awarded a $5 million contract to GTE Sylvania to test a mobile ELF system.

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UPDATE

Medical Applications.... *Physical Aspects of Hyperthermia,* the American Association of Physicists in Medicine summer school course held at Dartmouth College August 3–7, attracted 187 professionals from 11 countries. The 29 lectures will be reproduced in an AAPM monograph due out at the end of the year. For more information contact Anke Junge, executive secretary, AAPM, 335 East 45 Street, New York, NY 10017.... Funding for MIT Professors Philip Myers and Alan Barrett's microwave thermography system for detecting breast cancer has not been renewed, according to Dr. Thomas Rozzell of the Office of Naval Research.... Richard Borgens of the Jackson Lab in Bar Harbor, ME, and Ernesto Roederer and Melvin Cohen of Yale University describe the regeneration of the spinal cord in lampreys with applied electric fields in the August 7 *Science*.... The program for the first annual meeting of the Bioelectrical Repair and Growth Society scheduled for November 9–11 in Philadelphia is out. You can get a copy from the society at 425 Medical Education Building, 36th and Hamilton Walk, Philadelphia, PA 19104.... NMR imaging promises to be a major new medical tool, according to an expert poll published in *Forecast of Emerging Technologies,* a new FDA report to be released soon and mentioned in the July 30 *Nature.*

Technology.... Even though Xerox has abandoned its Xten digital communications network, other companies think they can make the service pay off. Satellite Business Systems, Tymnet Corp. and ISA Communications Services are seeking FCC approval to develop their own digital termination systems (DTS). The intra-city networks will operate in the 10.55–10.68 GHz band.... The thirteen companies now bidding to enter the direct broadcast satellite (DBS) service market are listed in the August 10 *Aviation Week & Space Technology*.... An article in the August issue of *IEEE Spectrum* outlines different technical approaches to DBS systems.... The US Army Medical Research and Development Command is seeking a contractor to develop a high peak power pulsed transmitter system for millimeter wave bioeffects studies (*Commerce Business Daily,* July 30, 1981).... OmniChuck, a new microwave heating system for processing silicon chips, has been developed by Machine Technology of Whippany, NJ. According to the August issue of *Microwaves,* OmniChuck, using pulsed 2.45 GHz radiation, is faster than infrared systems and does not require moving the wafers for baking.... Dayton T. Brown, Inc., of Long Island, NY, will receive $208,860 from the Bureau of Mines to study an electromagnetic transmitter for locating trapped miners.... The Bureau of Mines has awarded a $287,926 contract to the Xader Corp. of Springfield, VA, to investigate synthetic radar use in detecting coal mine hazards.

Government.... The Veteran's Administration Surgical Service's Ophthalmology Consulting Committee held its first meeting since November 1977 in Washington on August 10. Members of the committee are: Drs. Raymond Pilkerton (chairman), VA Medical Center, Washington, DC; James McDonald, VA Medical Center, Hines, IL; Arthur Chandler, VA Medical Center, Durham, NC; Ralph Stanifer, VA Medical Center, Houston, TX; Paul Whitmore, Walter Reed Army Medical Center, Washington, DC; and Budd Appleton, St. Paul Ramsey Hospital, St. Paul, MN.... The Bureau of Radiological Health has extended the comment period for its proposed rule on the measurement of leaks from microwave ovens. (See *MWN,* May 1981.) The Association of Home Appliance Manufacturers had requested the extension. The comment period will now run through October 23 (46 *Federal Register* 41102, August 14).

Military Systems.... The Air Force is proceeding with its plans for two additional PAVE PAWS installations (see *MWN,* May 1981). A contractor is being sought for a third-phased array radar facility at Robins Air Force Base, GA. The contract will include options on a fourth site in the Southwest (*Commerce Business Daily,* July 9).... Cobra Judy, a ship-mounted phased array radar for monitoring Soviet missile tests, should be operational late this year. According to the August 10 *Aviation Week & Space Technology,* the Air Force is currently testing the system. Cobra Judy, installed on the USNS Observation Island, includes a 22.5-ft. wide phased-array antenna housed on the ship's stern and two 32-ft. diameter radomes on its top.

Moscow Embassy.... The State Department has assembled nine volumes of documents relating to the irradiation of the US embassy in Moscow and is making them available through the Freedom of Information Act. The 2000-page set, covering events between 1964 and 1977, includes a volume on Project Pandora. The cost of the documents will be 10 cents a page at most; a full set would probably be considerably cheaper. For more information contact: Frank M. Machak, Information and Privacy Coordinator, Department of State, Washington, DC 20520.

Bioeffects.... There were some angry letters generated by last December's review article on RF/MW bioeffects by Eric Lerner. These together with Lerner's response are published in the August *IEEE Spectrum.*

Information and Litigation Center Set Up in Washington, DC

(continued from p. 1)

greater public awareness of the risks and benefits of microwave radiation.

According to present plans, the center will be a membership organization, with its own newsletter. While the center will help members obtain information relating to their microwave problem, it will not represent them in court. Instead, Lemle will refer potential complaints and lawsuits to participating attorneys. Information collected from members will be handled on a confidential basis. Membership fees will be set on a sliding scale.

Reppert and Lemle have been working together on FOIA appeals to release materials on the government's handling of the Moscow embassy affair. In 1976, Reppert broke many of the early stories on the Moscow irradiation and Project Pandora, a secret investigation into the biological effects of low-level microwave radiation; between 1977 and 1980 Reppert was a Moscow correspondent for the Associated Press. To date, Reppert and Lemle have collected more than 4,000 pages of documents from a host of federal agencies, including the State Department, the US Public Health Service, the National Telecommunications and Information Administration, the Defense Intelligence Agency, and other branches of the Department of Defense. (In a related development, the State Department has prepared nine volumes of documents on the history of the Moscow irradiation for public release: see above.) They currently have a FOIA suit pending against the CIA in federal district court in Washington, DC.

With respect to ongoing legal activity arising out of the Moscow microwaves, Lemle would only say that he knows of a number of administrative claims now pending.

The center is in the process of getting tax-exempt, nonprofit status. For more information contact: Stuart Lemle, Microwave Radiation Information and Action Center, 1320 19th Street, NW, Suite 200, Washington, DC 20036; (202) 775-0044.

MICRO WAVE NEWS

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

The Conference Calendar, scheduled to appear in this issue, will run next month.

ANSI Approves New RF/MW Safety Standard

After eight years of work, the American National Standards Institute (ANSI) has approved a new safety standard for exposures to radiofrequency and microwave (RF/MW) radiation. In certain frequency bands, the revised limits are up to a factor of ten times more stringent than the old 10 mW/cm^2 standard. In the absence of any federal guidelines, the new ANSI standard promises to be the de facto national RF/MW standard for some time.

Professors Saul Rosenthal and Bill Guy, who shepherded the revision through a seemingly endless series of debates and meetings, were both "delighted" that the standard had been approved and that their task was finally over. Many of the members of the ANSI C95 Committee on RF Radiation Hazards expressed a similar sense of relief. "It is a good standard and it represents significant progress over what we had before," said Dr. Moris Shore of the Bureau of Radiological Health (BRH). Guy said that he was pleased with the 90 percent consensus the standard won within the committee.

The new standard limits exposures to 1 mW/cm^2 in the 30–300 MHz frequency range. Above 300 MHz, the standard rises as a function of frequency until it reaches 5 mW/cm^2 at 1500 MHz, where it flattens out. Similarly, on the lower frequency side, it increases to 100 mW/cm^2 at 3 MHz. The standard covers the non-ionizing radiation spectrum from 300 kHz to 100 GHz.

The full text of the standard is reprinted on p. 2. Included in the standard is a rationale, which details the scientific and biological basis for the standard. For a copy of the complete standard, contact: ANSI, 1430 Broadway, New York, NY 10018, (212) 354-3300.

(continued p. 8)

RFI Standards Clear Congress

Congress has authorized the Federal Communications Commission (FCC) to set minimum performance standards for home electronic equipment to reduce their susceptibility to radio frequency interference (RFI). The action came as Congress tried to wrap up unfinished business before the August recess. The authorization was part of the Communications Amendments Act of 1982 (H.R. 3239) approved by both the House and Senate in voice votes after emerging from a House-Senate Conference. The President is expected to sign the bill into law.

The Conference Report accompanying the bill (House Report No. 97-765) sheds light on what Congress expects from the FCC. The conferees state that "millions of purchasers of television and radio receivers and other home electronic equipment and systems each year deserve protection from interference." They note that protective measures can be "simple and inexpensive," and that they do not intend "major modifications and redesigns of equipment to be required, or that the commission require steps to be taken which impose substantial additional costs or unnecessary burdens."

The conferees make it clear that they do not want state and local officials to

(continued p. 8)

ANSI C95.1-1982 STANDARD: Full Text

American National Standard Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields (300 kHz–100 GHz)

1. SCOPE AND PURPOSE

Recommendations are made to prevent possible harmful effects in human beings exposed to electromagnetic fields in the frequency range from 300 kHz to 100 GHz. These recommendations are intended to apply to non-occupational as well as to occupational exposures. These recommendations are not intended to apply to the purposeful exposure of patients by or under the direction of practitioners of the healing arts.

2. DEFINITIONS

Radio frequency protection guides (RFPG): The radio frequency field strengths or equivalent plane wave power densities which should not be exceeded without (1) careful consideration of the reasons for doing so, (2) careful estimation of the increased energy deposition in the human body, and (3) careful consideration of the increased risk of unwanted biological effects.

Specific absorption rate (SAR): The time rate at which radio-frequency electromagnetic energy is imparted to an element of mass of a biological body.

3. REFERENCES [Omitted]

4. RECOMMENDATIONS

4.1 Radio Frequency Protection Guides:

For human exposure to electromagnetic energy at radio frequencies from 300 kHz to 100 GHz, the protection guides, in terms of the mean squared electric (E^2) and magnetic (H^2) field strengths and in terms of the equivalent plane-wave free-space power density, as a function of frequency, are given in Table 1.

For near field exposures, the only applicable protection guides are the mean squared electric and magnetic field strengths as given in Table 1, columns (2) and (3). For convenience, these guides may be expressed as the equivalent plane wave power density, given in Table 1, column (4).

For mixed or broadband fields at a number of frequencies for which there are different values of protection guides, the fraction of the protection guide incurred within each frequency interval should be determined, and the sum of all such fractions should not exceed unity.

4.2 Exclusions:

(1) At frequencies between 300 kHz and 100 GHz, the protection guides may be exceeded if the exposure conditions can be shown by laboratory procedures to produce specific absorption rates (SARs) below 0.4 W/kg as averaged over the whole body, and spatial peak SAR values below 8 W/kg as averaged over any one gram of tissue.

(2) At frequencies between 300 kHz and 1 GHz, the protection guides may be exceeded if the radio frequency input power of the radiating device is seven watts or less.

4.3 Measurements:

(1) For both pulsed and non-pulsed fields, the power density, the squares of the field strengths, and the values of specific absorption rates (SARs) or input power, as applicable, are averaged over any 0.1 hour period. The time-averaged values should not exceed the values given in Table 1 or in the Exclusions, 4.2.

(2) Measurements to determine adherence to the recommended protection guides shall be made at distances 5 cm or greater from any object (refer to ANSI C95.3-1979).

5. EXPLANATION

Exposure to electromagnetic fields in the frequency range under consideration is but one of the several sources of energy input into the body, which requires wide ranges of energy production and dissipation in order to function. For situations involving unrestricted exposure of the body, the radio frequency protection guides are believed to result in energy deposition averaged over the entire body mass for any 0.1 hour period of about 144 joules per kilogram (J/kg) or less. This is equivalent to a specific absorption rate (SAR) of about 0.40 watts per kilogram (W/kg) or less, as spatially and temporally averaged over the entire body mass.

Biological effects data applicable to humans for all possible combinations of frequency and modulation do not exist. The radio frequency protection guide, therefore, has been based on the best available interpretations of the literature and is intended to eliminate adverse effects on the functioning of the human body.

Exclusion criterion (2) to the protection guides can be used in relation to fields from low power devices such as hand-held, mobile, and marine radio transceivers. These devices may emit localized fields exceeding the protection guides, but will result in a significantly lower rate of energy absorption than allowed for the whole body average. Thus, exposure to fields emitted by devices operating at 1 GHz or lower and at less than 7 watts output power would not be restricted. Exposure to fields from devices with greater output power or operating at frequencies above 1 GHz require a case-by-case analysis to determine if exclusion criterion (1) is applicable.

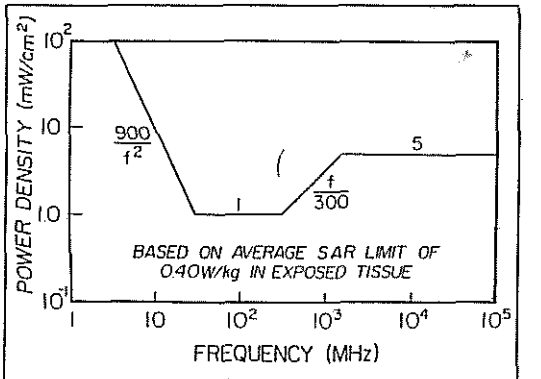
Because of the limitations of the biological effects data base, these guides are offered as upper limits of exposure, particularly for the population at large. Where exposure conditions are not precisely known or controlled, exposure reduction should be accomplished by reliable means to values as low as are reasonably achievable. Exposures slightly in excess of the radio frequency protection guides are not necessarily harmful, however, such exposures are *not* desirable and should be prevented wherever possible.

6. RATIONALE [Omitted]

Table 1
Radio Frequency Protection Guides

(1) Frequency Range (MHz)	(2) E^2 (V^2/m^2)	(3) H^2 (A^2/m^2)	(4) Power Density (mW/cm^2)
0.3–3	400,000	2.5	100
3–30	4,000 (900/f^2)	0.025 (900/f^2)	900/f^2
30–300	4,000	0.025	1.0
300–1500	4,000 (f/300)	0.025 (f/300)	f/300
1500–100,000	20,000	0.125	5.0

Note: f is the frequency, in Megahertz (MHz)



(ANSI RFPG for whole-body exposure of human beings.)

HIGHLIGHTS

Congressional Committee Urges Continued RF/MW Health Research – But Not at NTIA

A House-Senate Conference Committee has urged the Reagan Administration to continue research on the biological effects of radiofrequency and microwave (RF/MW) radiation. The committee noted, however, that the coordination of RF/MW research, now managed by the National Telecommunications and Information Administration (NTIA), might be better carried out by the Environmental Protection Agency (EPA) or the National Institutes of Health (NIH).

The committee said it was "disturbed" by the administration's NTIA budget request that eliminated funds for RF/MW radiation bioeffects research. (See *MWN*, May 1982.) It continued: "The conferees agree that this type of biological research should not fall within the purview of NTIA, which has no authority to issue a standard on non-ionizing radiation. However, the conferees believe that research should continue, under the auspices of a more appropriate agency, such as [NIH] or [EPA]. The conferees are aware of the budgetary constraints upon each of these agencies, but encourage NTIA to make available its research and experience so that the effects of non-ionizing radiation are better understood."

This directive is part of Conference Report (No. 97-765) accompanying the Communications Amendments Act of 1982 (H.R. 3239). (See story on p. 1.) Title II of the amendments is the authorization for NTIA's budget: $12.9 million for FY83 and $11.8 million for FY84. The report also instructs NTIA to do a comprehensive study of the "long-range international telecommunications and information goals" of the US with details on how to achieve them.

Fluorescent Light Linked to Skin Cancer

Exposure to fluorescent light at work doubled the incidence of skin cancer among a group of Australian women, according to a report in the August 7 *Lancet*. A study of 274 women with malignant melanoma, living in New South Wales, indicates that the risk of cancer increased with time spent under fluorescent light. The association could not be explained by history of sunlight exposure, skin or hair color, or any other factor. The finding was confirmed in a separate study of 27 men with melanoma.

Researchers from the London School of Hygiene and Tropical Medicine and the Sydney Hospital in New South Wales appear to be surprised by their own results, and advise caution in interpreting them until more data are collected.

They stress a number of curious aspects about their findings. First, while fluorescent lights at work had an effect, those at home were not associated with melanoma. Second, for both men and women the relationship between cancer and fluorescent light was strongest for lesions on the trunk of the body, an area usually covered by clothing – indicating that most clothes must be transparent to the biologically active wavelengths, whatever they may be. And third, compared to sunlight, fluorescent lamps emit much less ultraviolet-B light (280–315 nm), the radiation known to cause sunburns and therefore believed to be more likely to cause adverse effects. (On the other hand, fluorescent lamps emit a "jagged" spectrum in contrast to the "smooth" solar radiation spectrum: a difference ill-understood at the moment.)

Nevertheless, the authors might have answered some intriguing questions about melanoma. In the last 30 years – a period of significant growth in the use of fluorescent lights – the incidence of malignant melanoma has doubled all over the world. Also, there is an unexplained high rate of melanoma among office workers.

The English and Australian scientists argue that it is unlikely that their study is biased because they did not set out to link fluorescent light and cancer. Rather, they were investigating a possible connection between oral contraceptives and melanoma when the fluorescent light relationship turned up.

While this is the first report of an association between cancer and fluorescent light, a group from the Harvard School of Public Health and the University of Pennsylvania medical school found that fluorescent light "is capable of transforming cells in vitro and that the frequency of malignant transformation induced is related to dose." (See *Science*, March 14, 1980, p. 1209.) They concluded that, "Fluorescent light exposure could contribute on a small scale to human skin carcinogenesis."

Communications Industry Seeks Federal Radiation Rules

The broadcasting and communications industries have urged the Federal Communications Commission (FCC) to preempt state and local microwave radiation exposure standards. Fearing that a patchwork of restrictive regulations is on the way, companies and trade associations have asked the commission to adopt an interim guideline for assessing radiation hazards while work on a federal standard continues at other agencies. They also want the commission to help shape and support these federal efforts.

These recommendations were submitted to the FCC in response to its January 28 notice of proposed rule making. The commission is now in the second stage of a proceeding, begun in 1979 with a "notice of inquiry," to ensure that the facilities and equipment it authorizes do not expose workers or the public to hazardous levels of RF/MW radiation. In an effort to meet its responsibility under the National Environmental Policy Act (NEPA), the FCC has proposed adding applications for facilities exceeding federal exposure limits to a list of "major actions" requiring environmental assessment.

The proceeding has hit a snag, however, because the FCC lacks the expertise and jurisdiction to develop its own standard and the only federal exposure guideline is now being revoked. The Occupational Safety and Health Administration's (OSHA) recent decision to abolish its exposure guidance has left the commission without a federal rule on which to base its regulations. The Environmental Protection Agency (EPA) and OSHA are both working on standards but neither is expected to publish a rule for several years. And although the new American National Standards Institute (ANSI) guideline is available to serve as an interim standard (see p. 1), this option is barred by the FCC's policy decision to leave standards setting to other qualified government agencies. (ANSI is a voluntary, non-governmental group.) The commission must now determine how it can proceed, if at all.

In an almost desperate search for a national standard, many commentators recommended adopting either the old OSHA or the new ANSI standard for the time being. OSHA's 10 mW/cm^2 limit was recommended by the National Association of Broadcasters, the Association for Broadcast Engineering Standards, CBS and the TV Broadcasters All Industry Committee. GTE was among those recommending the new ANSI standard, which drops the allowed limit to 1

mW/cm^2. GTE reasoned that "the Commission does have the expertise to *recognize* a technically sound radiation standard and...adopt it as an interim standard." The American Radio Relay League, stating that OSHA's move "would effectively knock the underpinnings out" of the FCC's proposed rules, also recommended adopting the new ANSI standard.

Two industry submissions advised against any action until a federal standard is in place. RCA, while endorsing "the concept" of the FCC's plans to satisfy its obligations under NEPA, warned that it is impossible to foresee what the final federal standard will be and that regulations adopted now "may be ineffective, inappropriate, or detrimental" to those regulated. The Utilities Telecommunications Council stated, "In view of the fact that the various federal agencies... are only in the preliminary stages of standard development and in light of the disparate views and positions of scientists the world over concerning what constitutes a radiation 'hazard,'" the FCC should evaluate its position after the US has an enforceable standard.

The comments from EPA questioned the wisdom of using an occupational standard for the general population. EPA advised that OSHA's guidance "may not provide adequate protection for certain segments of the public" and that until EPA adopts a standard, the commission "should consider using a more conservative approach to evaluating public exposure."

Multnomah County, OR, which recently adopted an exposure standard five times more strict than ANSI's, stated that 10 mW/cm^2 "is inappropriately low for some frequencies and high for others...." The county also advised the commission to clarify its position on federal and local jurisdictional conflicts.

Although two commentators stated that a blanket standard might affect some UHF-TV stations (CBS and the National Association of Public TV Stations), and a few recommended categorical exclusions for certain sources, the consensus was that a standard in line with OSHA's 10 mW/cm^2 guideline or the new ANSI 1 mW/cm^2 limit would not adversely affect industry. Merchant ship satellite transmitters were the only source singled out as posing a potential health risk. The National Marine Engineers' Beneficial Association asked the FCC to adopt standards "to provide for the safe operation" of this equipment.

The FCC's Dr. Robert Cleveland could only speculate about what the commission will do next. Options include promulgating a final rule, revising the proposal and issuing a new notice of proposed rule making, waiting for EPA or OSHA to issue standards, and dropping the rule altogether. Cleveland conceded that it was unlikely that the commission would cancel its proposal. If the commission does go ahead, a revised or final rule could be ready by next spring. The comment period for the FCC notice of proposed rule making ended on August 16. Reply comments are due October 18.

Comments On FCC Proposed Rules: Selected Excerpts

A total of 18 sets of comments were received by the FCC before the August 16 deadline. Those filing were: Thomas Charles Agoston, the American Radio Relay League, AT&T, CBS, the Association for Broadcast Engineering Standards, Doubleday Broadcasting, the Environmental Protection Agency, GTE, Motorola, Multnomah County, OR (two comments), the National Association of Broadcasters, the National Association of Public Television Stations, the National Marine Engineers' Beneficial Association, RCA, Satellite Business Systems, the TV Broadcasters All Industry Committee and the Utilities Telecommunications Council.

American Radio Relay League: ARRL believes that, given the intermittent nature of Amateur Radio operation and the relatively low powers used, it is appropriate to exempt Amateur Radio [as major actions under FCC NEPA rules].

Association for Broadcast Engineering Standards: Because of the lowness of the portion of the frequency spectrum which they occupy and their relatively low power levels, AM broadcast stations do not present a likely threat of adverse biological effects to either the public at large or to station employees....With regard to FM and television services it may also be found that, while they operate at higher frequencies, the observed levels of RF radiation from such transmitters are well within the advisory OSHA standards of exposure as far as the general public is concerned.

AT&T: AT&T urges the commission to make clear that the proposed rules are addressed to real, not merely hypothetical, situations in which the emission or exposure guidelines would be exceeded.

CBS: Local standards may unnecessarily impair the ability of communications systems to operate as authorized by the commission. Consequently, it may be difficult for newer services, such as low power television, cellular communications, DBS and MDS to commence operations. Moreover, such restrictions could endanger the commission's basic allocation policies, seriously impacting broadcast radio and television and non-broadcast services. Most likely, in the broadcast services, restrictions will fall heaviest upon UHF television — making it unlikely that the Congressional mandate to achieve UHF/VHF comparability could be achieved.

Doubleday Broadcasting: Because of the concern of the [New York] City and the Port Authority of New York and New Jersey, for radiation levels created by the broadcast facilities [WAPP (FM)] at the World Trade Center, Doubleday cannot be assured that it will be permitted to retain its facilities in place. The Congress of the United States cannot have contemplated that the operation of a facility licensed by the commission could effectively be ordered to be silenced, or worse yet, removed, simply by the application of a highly restrictive radiation standard by a local jurisdiction.

Environmental Protection Agency: We plan to publish proposed guidance for public comment by fall 1983, and final guidance approximately one year later. Until such time, FCC should consider using a more conservative approach to evaluating public exposure than that provided in the OSHA standard.

GTE: The commission should exclude services and operations where the power levels or intermittency clearly make it unnecessary to file estimates of levels (e.g. land mobile, citizen's band, amateur radio, etc.).

Motorola: Categorical exclusion [from FCC NEPA rules] could be most useful to the commission and its licensees by providing for an explicit listing of those types of radiofrequency devices which have been determined to be "categorically safe" by virtue of inherent physical design, specifics of use, etc. This would negate the need for licensees to make necessary (and often very difficult) measurements to ascertain adherence to the various prescribed standards. Also a positive assurance of safety would be provided by the commission to the public in such cases.

Multnomah County, OR (Donald Clark, County Executive): [The FCC] does not make clear how the commission would treat local standard-setting once the commission adopts a mandatory federal standard. Will the federal standard supercede local actions to the contrary? Can local governments adopt and enforce a standard which is more strict than the federal standard? The commission should clearly address this issue during rulemaking. *And,* We note that no local or state governments responded to the Notice of Inquiry. Practically all respondents to that inquiry were industry representatives. There is

concern that the commission may not be aware of the significant local concerns about this issue. The commission is urged to make an effort to contact state and local governments.

National Association of Broadcasters: NAB urges the commission to base its regulations on the 10 mW/cm² standard long recommended by the Occupational Safety and Health Administration (OSHA).... Should the commission choose the new ANSI standard, NAB believes the broadcast industry will generally be able to meet it, although there may be some installations that would require special considerations. *And,* Rather than uniformly applying its radiation standards to all services, the commission should instead apply them only to fixed services operating at sufficiently high ERP levels to create any possible hazard. To specially scrutinize applications in "any service" would constitute regulatory overkill—and is not required of the commission under the National Environmental Policy Act (NEPA).

National Association of Public Television Stations: NAPTS also urges the commission not to take any action which would unnecessarily discourage the shared use of antenna sites by television broadcasters. *And,* NAPTS asks the commission not to take any action which unnecessarily disadvantages UHF television stations. Some 60% of public television stations operate in the UHF band, so any extra burden imposed on UHF stations would fall disproportionately on public television. This is not to say that NAPTS advocates permitting the existence of hazardous conditions, for it does not; but neither should the commission impose restrictions which are not clearly shown to be necessary to preserve the health and welfare of the public.

National Marine Engineers' Beneficial Association (Radio Officers Union, District 3): The ROU is adamant in its objection to in-port operation of satellite equipment with regard to tankers, LNG carriers, ammunition ships, and similar vessels engaged in cargo operations. The possibility for a catastrophic event triggered by a radiating ship satellite antenna is obvious. *And,* The principal hazard posed by ship earth terminals is the fact that their antennas are frequently mounted only a few feet above deck level.

RCA: The current status of federal non-ionizing radiation emission and exposure standards is as follows: BRH has not issued an RF emission standard (other than for microwave ovens); EPA has not issued a public exposure standard; and, OSHA is in the process of revoking its worker exposure standard. Thus, if the commission now proceeds to adopt its proposed regulations for implementing NEPA, it will have no basis for evaluating compliance with Federal radiation health and safety standards.

Satellite Business Systems: The transmissions from SBS's earth stations will not exceed 10 mW/cm² even directly in front of the antenna. As SBS pointed out in its comments in response to the commission's 1979 Notice of Inquiry, earth stations by their very nature would present little danger to workers or the public even when operated at powers above 10 mW/cm². As parabolic antennas used with earth stations direct the radio frequency emission in a narrow beam upward toward the satellite and, further, as access to such antennas is restricted, there is little chance of exposure to workers or the public.

TV Broadcasters All Industry Committee: The new ANSI C95.1 standards reflect an effort to formulate a frequency-dependent approach to RF radiation standards. While the ANSI standards are more stringent than the 10 mW/cm² standard at certain frequencies, they are not so stringent as to impair broadcasting services. Thus, if EPA or OSHA find it scientifically necessary to adopt the ANSI standards, the committee would not object to their use by the commission—even though there is no credible evidence that the 10 mW/cm² standard is inadequate.

Utilities Telecommunications Council: UTC opposes implementation of the commission's proposal at the present time. In view of the fact that the various federal agencies responsible for setting public exposure standards are only in the preliminary stages of standard development and in light of the disparate views and positions of scientists the world over concerning what constitutes a radiation "hazard," UTC submits that it would be premature for the commission to begin enforcing OSHA's present recommendation of 10 mW/cm² when reviewing applications for equipment or construction permits. ●

UPDATES

Biological Effects...In our March 1981 issue, we reported that an army pathologist had observed an association between chronic exposure to microwaves and polycythemia vera, a rare blood disease, in the El Paso, TX area. Now comes word from Atlanta, GA, that local doctors have identified some 25 cases of polycythemia among people living near the Savannah River plant in South Carolina. At first, many suspected ionizing radiation might be involved, given that radioactive materials are handled at the nuclear weapons plant, but no definitive assessment will be available for some time. A spokesman for the South Carolina Department of Health said that a study is underway with the cooperation of Georgia health officials and experts from the Centers for Disease Control (CDC) in Atlanta. (The plant is near the Georgia border.) Protocols are being designed, and the results of the study may take as long as a year. CDC's Dr. Robert Winslow said that there was little to go on at the moment and that researchers were having a hard time tracking down all the cases; he could not yet confirm that there were indeed 25 cases of polycythemia ....The American Institute of Medical Climatology (AIMC) is sponsoring a conference on *Environmental Ions and Related Biological Effects* on October 30 at Drexel University in Philadelphia, PA. One of the principal topics to be discussed is high voltage direct current transmission lines. The fee for AIMC members is $25, for others it is $35. For more information contact: AIMC, 1023 Welsh Road, Philadelphia, PA 19115, (215) 673-8368....The AIMC has compiled a comprehensive and critically annotated bibliographic literature review of the biological and behavioral effects of exposure to air ions. It is available for $65 from Dr. Jonathan Charry, Rockefeller University, 1230 York Avenue, New York, NY 10021.... EPA's Experimental Biology Division has awarded a $34,000 contract to Kunz Associates of Albuquerque, NM, to develop a computer code to calculate microwave energy deposition with a high spatial resolution. And the division is negotiating a contract with Dr. Aaron Saunders at Duke University Medical School for a study of the interaction of RF/MW radiation with the brain energy metabolic pathway....The first *International Conference on Psychophysiology* was held in Montreal, Canada from July 29–August 1. One session, chaired by Dr. Jose M.R. Delgado, was on "Biomagnetism in Psychophysiology," and featured papers by Drs. Ross Adey, Andrew Bassett, Eldon Byrd, John de Lorge, Sylvia Filton-Jackson, H. Weinberg, P.A. Brickett, L. Deecke, J. Boschert as well as Delgado....In a special review and tutorial article, Professors C.K. Chou and Bill Guy review auditory perception of RF fields in the June issue of the *Journal of the Acoustical Society of America.* The authors conclude that "the evidence is now strongly convincing that the hearing phenomenon is related to a thermoelastically induced mechanical vibration." They explain, "absorption of microwave energy produces nonuniform heating of the exposed head; a thermoelastic wave of pressure is then launched, presumably through bone conduction, to the cochlea where it is detected."

Communications...CBS has released the results of a two-month experiment in broadcasting TV in the 12 GHz band. CBS found the tests "encouraging" even though "satisfactory reception depends on line-of-sight availability from the transmitting antenna to the receiving antenna" and "rain attentuation is considerable." CBS has argued that the FCC should allocate part of the 12.2–12.7 GHz band for high-definition TV (HDTV) instead of reserving it exclusively for direct broadcast satellite (DBS) systems. The CBS report concludes that, "If the 12 GHz band were made available for the terrestrial broadcasting of HDTV, there can be little doubt that the ingenuity of the broadcast community would develop the necessary techniques to provide a viable broadcast service."...ITT is having problems siting a

20-watt relay tower in South Nyack, NY, one of several planned between Newark, NJ, and Boston, MA. After meeting stiff community opposition at an August 10 town planning board hearing, the company withdrew its proposal. Though the local citizens are worried about the health effects of microwaves, the principal objection is to the visual "blight" caused by an 85-foot tower. ITT attorney Susan Whitman said that a new proposal is now being submitted to the Rockland County and the South Nyack planning boards....In Coventry, CT, another link in ITT's proposed network, a citizen's group is appealing that town's approval of a tower to the state's Superior Court (see *MWN*, June 1982). A trial date of October or November is expected....EPA's Paul Gailey and Richard Tell will present a paper on "Assessing the Potential Impact of Federal Radiation Safety Regulations on the FM Broadcast Service" at the 32nd annual *IEEE Broadcast Symposium,* to be held at the Washington Hotel in Washington, DC, September 16–17....The FCC, in another move toward deregulating the broadcast industry, has proposed lifting its restrictions on FM radio subcarrier use. The underused part of a station's assigned frequency band will now be available for paging services, electronic mail and other private transmissions....Citing heavy demand, the FCC has allocated eight additional frequencies in the 35 and 43 MHz bands for one-way paging systems....The fast growing subscription TV market has quadrupled in two years, to about 1.5 million viewers, with the number of stations climbing from 8 to 31. For a close look at the future of STV, see the August 16 *Broadcasting.*

Compatibility & Interference...The Bureau of Mines is continuing to sponsor research on the potential interference of low and medium frequency (30 kHz–3 MHz) radio signals, used for communications inside mines, with blasting caps. The bureau notes that "long propagation distances and the complexities of near-field radiation patterns make worst case predictions of the blasting hazard very difficult." Ramie Thompson of the Franklin Research Institute in Philadelphia, PA, will be the principal investigator for a new year-long study.... The wrangling over Radio Marti continues in Congress. Although the House passed H.R. 5427, based on the administration's proposal, by a vote of 250–134, a companion measure did not clear the Senate Foreign Relations Committee. Senator Edward Zorinsky (D-NE) succeeded in delaying the bill until after the August recess. Backstage negotiations promise to continue unabated. The National Association of Broadcasters (NAB), one of the major participants in the debate, released a study outlining the feasibility of using a broadcast frequency of 1610 kHz, which is outside the commercial AM band. That alternative or using shortwave frequencies would lessen the likelihood that Cuba would retaliate by using high-power transmitters to disrupt more than 200 AM stations. A copy of the NAB study appears in the August 10 *Congressional Record,* p. H5566....The FCC has reaffirmed its earlier ruling that its Field Operations Bureau has the authority to temporarily shut down transmitting equipment which is causing dangerous interference. CBS and NBC had asked the commission to reconsider its decision (see *MWN,* March 1982), based on an interference incident during the first flight of the Space Shuttle ....The FCC has delayed the deadline for filing comments on its proposal to reduce interference from educational FM stations until after the commission releases its report, *Options for Relief of Interference to TV Channel 6 from Educational FM Stations*....Three new FCC reports are available now: *A Computer Program for Calculating Effective Interference to TV Service* by H.K. Wong (No. OST TM 82-2), *Field Tests of 216 to 220 MHz Transmitters for Compatibility with Television Channels 13 and 10* by H. Davis (No. OST TM 82-4) and *Guidance for Evaluating the Potential for Interference to TV from Stations of Inland Waterways Communications Systems* by R. Eckert (No. OST TM 82-5). A limited number of copies of each report is available from the FCC's Office of Public Affairs, Room 207, 1919 M St., NW, Washington, DC 20554. Otherwise they can be purchased from the Downtown Copy Center, 1114 21st St., NW, Washington, DC 20037, (202) 452-1422.

Government...At its July 29 meeting, members of FMAC completed work on its statement on RF/MW safety. (See *MWN,* January/February 1982). The FMAC draft is now circulating among the ERMAC membership — many of whom have reservations about the FMAC language. ERMAC's Janet Healer said that she hoped to hold a meeting of the advisory council in September or October to finalize the joint FMAC/ERMAC statement....Although the Radiation Policy Council went out of business last September 30, at the end of the FY1981 (see *MWN,* October 1981), its official demise came this August 17. On that date, President Reagan signed Executive Order No. 12379, which reversed President Carter's Executive Order No. 12194, issued in February 1980, that originally set up the council.... The CPSC has published a consumer product safety standard for omnidirectional CB base station antennas to reduce the risk of electric shock. The commission estimates that between 1975 and 1977, the peak years for CB antenna sales, over 700 people were electrocuted while putting up or taking down communication antennas, about 60 percent of which were omnidirectional CB antennas.

Measurement....EPA is seeking a contractor to measure the radiation patterns, over 360 degrees of azimuthal rotation, for 10-foot paraboloidal, microwave dish antennas — the type used in point-to-point transmission systems and, when larger, for satellite communications. Among the models to be tested are Andrews Corp.'s dishes operating at 2, 4, 6 and 11 GHz. EPA wants to generate information on the gain in the side-lobe regions and to compare the experimentally determined patterns with those obtained from theoretical calculations. Responses to RfP CI 82-0908 were due on September 2.... The FCC has decided to shelve a proposed rule that would have required the filing of a description of measurement facilities used for the authorization testing of RF devices. The proposal would have set requirements for determining the suitability of a site by measuring open field site attenuation — that is, how much a radio signal decreases as it travels from one side of the site to the other. The principal reason for dropping the proposal is that ANSI committee C63 is now working on a voluntary standard for test sites, as is CISPR. The eighth draft of the C63 ANSI standard is now circulating among members of the C63.1 subcommittee and could come up for a vote by the full committee at a meeting on October 20. The FCC has published Bulletin OST 55, *Characteristics of Open Field Test Sites* in the *Federal Register,* (47 *FR* 36427, August 20)....NBS scientists have devised a method of estimating electromagnetic field strengths inside enclosed spaces. Mark Ma and M.G. Arthur of NBS's electromagnetic field division in Boulder, CO, explain their model and provide the relevant equations and computer programs in their report, *A Study of the Electromagnetic Fields Distribution Inside Buildings with Apertures Excited by an External Source* (NBSIR 82-1659). It is available from the National Technical Information Service, Springfield, VA 22161 for $12.00. Order No. PB 82-193418....James Oleson of the University of Arizona's Division of Radiation Oncology has devised a new probe, which can measure and map relatively intense magnetic fields of known frequency such as those associated with hyperthermia devices like the Magnetrode unit operating at 13.56 MHz. The HF probe has an accuracy of ±5 percent. See the August issue of *IEEE Transactions on Biomedical Engineering.*

Medical Applications...How do weak electromagnetic fields speed up the healing of nonunion fractures? Some new insights are provided by a team headed by Dr. Richard Luben of the University of California, Riverside, and Dr. Ross Adey of the VA Hospital at Loma Linda, CA. They examined the effects of a continuous train of single pulses at 72 Hz and of recurrent bursts of shorter pulses, repeated at a 15 Hz rate: they found no significant differences. Writing in the July issue of the *Proceedings of the NAS,* the researchers suggest that field effects are "mediated primarily at the plasma membrane of osteoblasts [bone forming cells], either by interference with hormone-receptor interactions or by blocking of receptor-cyclase coupling in the membrane."...NBS and the American Association of Physicists in Medicine have prepared the *Medical Physics Data Book,* a handbook of numerical data for practicing doctors in the operation and maintenance of equipment used for diagnosis and treatment. One of the chapters is devoted to non-ionizing radiation, including visible, MW, RF and ultrasound. It is available from the Superintendent of Documents, Government Printing Office, Washington, DC 20402 for $5.50. Order No. 003-003-02391-4....A team from the University of Illinois, Urbana, describes a minicomputer system that can control the microwave power, at 2450 MHz, to four local hyperthermia applicators in Volume 3, Number 3 of *Bioelectromagnetics.* The system

can regulate the temperature in tumors to within 0.1°C and can prevent skin burns.... Among the papers to be presented at the fourth annual meeting of the IEEE Engineering in Medicine and Biology Society, *Frontiers of Engineering in Health Care,* September 20–21 in Philadelphia, PA, are "The Human Eye in the Presence of Electromagnetic Radiation" by S.C. Gupta of the University of Roorkee, India, and "Nonlinear Electromagnetic Interaction with Living Systems" by Eldon Byrd of the Naval Surface Weapons Center in Silver Spring, MD. Immediately following that meeting, on September 22, M. Osbakken of the Pennsylvania State University Medical Center will discuss "NMR: Imaging and In Vivo Metabolism" at the *Frontiers of Computers in Medicine* meeting.

Military Systems ... The air force's over-the-horizon backscatter (OTH-B) radar, now operating as an experimental program at the Moscow AF station northwest of Bangor, ME, is going into full-scale development under a new $66.7 million contract with General Electric Co., according to an article in the August 16 *Aviation Week & Space Technology.* The experimental system uses 12 high-frequency transmitters, each rated at 100 kW average power with a multi-band array 2,265 feet long. The expansion of the present system to cover a 60-degree sector will cost about $240 million and will require the addition of 1,365 feet to the antenna. Additional land will be bought to further expand the radar system to include two additional 60-degree sectors for full 180-degree coverage of the East Coast. The system will operate in six different frequency bands between 5 and 28 MHz. *Aviation Week* notes that the AF has yet to determine the location for the West Coast OTH-B radar, and that it also plans to look for a southern site....Meanwhile, the AF's Electronic Systems Command at Hanscom AFB, MA, has identified a need for an independent verification of the OTH-B radar system's software. The system uses a real-time distributed network of 14 VAX computers.... Contract negotiations between the navy and GTE Sylvania for Project ELF are continuing. By mid-September, the company's cost proposal for upgrading the Wisconsin Test Facility, producing the Michigan transmitter and antenna and developing 20 model receivers should be submitted to the navy. A contract should be ready for signing two to four months later....On August 4, the *New York Times* reported that the development of the Stealth bomber, which is designed to escape radar detection, was three years ahead of schedule, and could be deployed by 1988. The Pentagon, however, rejected the proposal to accelerate the Stealth bomber project, favoring instead to continue funding the B-1 bomber. The first Stealth air-launched cruise missile will be ready this year, the article noted.... A House Appropriations Committee report alleges that the Ticonderoga, the first navy Aegis cruiser, is so overweight with sophisticated radar and electronic equipment that it is in danger of capsizing. DoD immediately denied the allegation....The August issue of *Defense Electronics* features a survey article "The Deadly Game: Search Radar Versus Aircraft" by Eaton Corp.'s Edwin Drogin....Satellite Systems & Technology of Falls Church, VA, is sponsoring a three-day short course on *Trends in Military Satellite Communication Systems* to be held in the Washington, DC, area October 25–27 and in the Los Angeles area November 15–17. The fee is $650. For more information, contact: SS&T, (703) 532-6274.

Ovens ... Some 250 people attended the International Microwave Power Institute's (IMPI) 17th annual meeting in San Diego, CA, at the end of July. About 200 of them were from IMPI's Cooking Appliance Section (CAS), and there were papers on a host of issues, including the much discussed warnings about the risks of cooking pork —or rather its incomplete cooking—in a microwave oven. The proceedings of the meeting have not been assembled this year. According to IMPI Executive Director Dan Lynch, a committee, chaired by Walter Wyslouzil of the National Research Council of Canada in Ottawa, is in the process of deciding how to disseminate the papers. Abstracts of the papers are in the July-August issue of *Microwave World,* the CAS bimonthly newsletter. Some of the papers on CAS-related topics will appear in future issues of that newsletter....On October 8, IMPI will sponsor a one-day seminar on *The Microwave Oven Industry: Research, Trends and Changes* at the Marriott's Tan-Tar-A Resort & Golf Club at Osage Beach, MO. The registration fee is $45. For more information, contact CAS at IMPI headquarters in Vienna, VA, (703) 281-1515.... In the June issue of the *Journal of Microwave Power,* Robert Decareau of the US Army Natick R&D Food Engineering Lab in Massachusetts describes the lab's work on applying microwave energy to food processing, with special attention on freeze-drying and in-pouch sterilization....The controversy over minimum energy efficiency standards for appliances, including microwave ovens, has died down. Meanwhile, DOE is negotiating a contract with Arthur D. Little of Cambridge, MA, for a technical and economic analysis of such standards....The head of the IRS is putting a microwave cooking center into his office. The August 11 *Washington Post* reports that IRS Commissioner Roscoe Egger Jr. wanted a bigger kitchen to make meals for himself and official visitors....Shipments of microwave ovens continued to be slower than last year: a 10 percent decline in July 1982 compared to July 1981. Nevertheless, according to statistics compiled by the Association of Home Appliance Manufacturers, the 331,000 ovens shipped in July represented the second highest for any July in history—exceeded only by last year....See also Standards Update below.

Power Lines...A draft report on the health effects of high power DC lines is scheduled for release early this September by a scientific advisory panel of the Minnesota Environmental Quality Board. The board will use the final report, due in early November, and two other state studies now underway to reevaluate its power line siting and operating permit requirements....See also Bioeffects Update above.... DOE has published *Biological Effects of High-Strength Electric Fields on Small Laboratory Animals* (No. DE 82002426), an interim report on research done at the Pacific Northwest Laboratory in Richland, WA, from October 1, 1979 to March 31, 1981. Though dated July 1981, the report was only released this August. Copies are available from the National Technical Information Service, Springfield, VA 22161.

Standards...The Committee on Electrical Approvals Standards of the Standards Association of Australia has drafted a proposed standard for microwave leakage detectors for household use. For more information contact the association at 80 Arthur Street, North Sydney, Australia....The August issue of the *IEEE Spectrum* reviews the recent Supreme Court ruling against the ASME, which could have a profound impact on voluntary standard-setting organizations. (See *MWN,* June 1982.)...The IEEE reports that one positive side effect of the ASME decision is that the FTC may now decide to drop any plans to regulate standard-setting bodies....The International Electrotechnical Commission (IEC) has published a number of standards (IEC-487-2-1, 487-2-2, 487-3-2 and 487-3-3, all 1981) on methods of measurement for equipment used in radio-relay systems. And the IEC's International Special Committee on Radio Interference (CISPR) has published CISPR-15-1981 on the limits and methods of measuring RFI characteristics of fluorescent lamps and CISPR 17-1981 on ways of measuring the suppression characteristics of passive radio interference filters and components. For more information contact ANSI's sales office, 1430 Broadway, New York, NY 10018, (212) 354-3300.

VDTs...The Ontario Public Service Employees Union (OPSEU) has won major concessions for VDT workers in its new contract with the Ontario government. The new rules include eye examinations when workers are assigned to VDTs with follow-up exams every six months, ten-minute breaks for every hour of continuous VDT work and alternative jobs for pregnant operators upon request. Women who request the change would be paid at the wage rate of the interim job. The union's Bob DeMatteo called the agreement "a breakthrough" but said the union intends to seek clarification on the potential loss in earnings because it conflicts with another agreement. According to their present contract, OPSEU members cannot lose pay when transferred because of a health problem....The management of the *Toronto Star* and officials of the Newspaper Guild have agreed that an investigation into the 1980 cluster of infants with birth defects born to *Star* workers is no longer possible. On July 29 the paper reported that only one of the four women involved would participate in a long-awaited, independent study....A Canadian report released early this year concludes that VDTs do not pose radiation hazards but, "The effect of static electric fields at the VDT work-

station requires further investigation." *Review of Health and Safety Aspects of Video Display Terminals,* CRC Technical Note No. 712-E, was published by the Communications Research Center of the federal government's Department of Communications in Ottawa .... National Public Radio's report on VDTs and pregnancy problems, aired on *All Things Considered* on August 4, has generated an unusual amount of listener interest. A transcript of the report is available for $1 and a cassette is $15 from Audience Services, NPR, 2025 M Street, NW, Washington, DC 20036....T.K. Daneshmend and M.J. Campbell, at the Frenchay Hospital in Bristol, UK, have proposed "electronic space war video game epilepsy" as a special category of photoconvulsive epilepsy. In the June 12 *British Medical Journal,* they describe the case of a 17-year-old girl who had an epileptic fit while playing Dark Warrior. In a previous case reported by Dr. D.N. Rushon in the February 28, 1981 *Lancet,* a 17-year-old boy had a grand-mal seizure while playing Astro Fighter. The games' bright flashing lights are thought to cause the seizures in certain individuals. ...A number of European experts will participate in the *International Conference on Office Work's New Technology* October 28-29 in Boston, MA. For details, contact Working Women Educational Fund, 1224 Huron Road, Cleveland, OH 44115, (216) 566-9308....Vincent E. Guiliano of Arthur D. Little expects that 40 to 50 percent of all US workers will use VDTs daily by 1990. Guiliano examines the changes brought by the information age in "The Mechanization of Office Work," which appears in the September *Scientific American.*

ANSI *(continued from p. 1)*

The new standard was not approved unanimously. Dissenting votes were cast by Leo Birenbaum of the Polytechnic Institute of New York, Allan Eckhaus of Consumers Union and Howard Johnson of RCA, representing the Electronic Industries Association. Persons objecting to the standard have the right to appeal, but all three parties told *Microwave News* that they did not intend to do so. David Janes of the Environmental Protection Agency (EPA) abstained from voting on the proposal.

A major bone of contention within the committee was whether the standard should apply to general public as well as to occupational exposures. At one point in the negotiations, for instance, BRH refused to approve the standard without cautionary language, leading to the following compromise sentence: "Because of the limitations of the biological effects data base, these guides are offered as upper limits of exposure, particularly for the population at large."

RCA's Howard Johnson objected to a voluntary group setting a public health standard, maintaining that the job should be done by the federal government. (Johnson retired this spring.) George Kiessling, RCA's director of product safety, echoing Johnson's concerns, said that, "We still need a federal standard; given the recent actions of Multnomah County and Massachusetts, it will be a free for all until the government acts." Multnomah has set and Massachusetts has proposed population standards with limits as low as 200 uW/cm^2 — a factor of five lower than ANSI's. (See *MWN,* July/August and March 1982.)

Both the EPA and the Occupational Safety and Health Administration (OSHA) are scheduled to release advanced notices of proposed rulemaking on RF/MW radiation this September. EPA is working on a guidance for population exposures and OSHA is developing a new occupational standard to replace its now deleted 10 mW/cm^2 advisory standard —which was based on the original ANSI standard.

Other points of disagreement included the six-minute averaging time for measuring exposures, the exclusion from the standard of devices with an input power of seven watts or less and the absence of criteria for exposures to pulsed radiation and for partial body exposures.

One indication of the difficulties in reaching consensus is that Guy submitted his resignation as chairman of the subcommittee (C95.IV) drafting the revisions on August 20, 1980 —to take effect as soon as the standard was approved. Guy is the director of the Bioelectromagnetics Research Laboratory at the University of Washington, Seattle.

Dr. F. Kristian Storm, an associate professor of surgery and oncology at the UCLA School of Medicine will now take over the chairmanship of the subcommittee. In a telephone interview, Storm said that he had several thoughts about how to improve the organization of the subcommittee. He cited one example: bringing more physicians and biological scientists into the evaluation process.

According to ANSI rules, all standards must be reevaluated every five years. The original 10 mW/cm^2 standard, for all frequencies between 10 MHz and 100 GHz, was adopted in 1966 and reaffirmed in 1974. Given the length of time revisions have taken, Rosenthal, a professor of electrical engineering at the Polytechnic Institute of New York, said "I am glad the standard is out but now it's time to start again."

In other standard setting news, the American Conference of Governmental Industrial Hygienists has proposed modifications to their standard, which is similar to ANSI's. (See *MWN,* July/August 1982.) And the Department of Defense (DoD) is reviewing its RF/MW standards. Although the DoD review is not yet complete, participants from the three services —army, navy and air force—are in general agreement with the ANSI revision. (See *MWN,* May 1982.)

RFI Standards *(continued from p. 1)*

set RFI regulations, stating that "the exclusive jurisdiction over RFI incidents (including pre-emption of state and local regulations of such phenomena) lies with the FCC."

In its section-by-section analysis of the amendments, the conferees grant the commission the discretion of not setting specific standards. Warning labels are cited as a possible alternative. But they are clear on their objective: "The conferees expect the number of interference complaints recorded and investigated by the commission to be significantly reduced."

Any FCC rules would apply to all electronic equipment designed for home use, even though it might be used outside the home. Thus, the conferees make specific reference to portable radios and televisions. Devices for business and office use are exempt.

In prohibiting local RFI standards, the conferees state that "radio transmitter operators should not be subject to fines, forfeitures or other liability" by state and local governments as a result of RFI to home electronic equipment.

The authority to set RFI standards was originally contained in S. 929, sponsored by Senator Goldwater (R-AZ) and in H.R. 5008 sponsored by Congressmen Timothy Wirth (D-CO) and Allan Swift (D-WA). The House-Senate Conference resolved the differences between the two bills.

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

EMC'83: A Booming Business

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

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

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

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

Computer RFI

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

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

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

(continued on p. 2)

EMC'83 *(continued from p.1)*

ISM Equipment

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

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

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

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

Computers Aboard Aircraft

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

Computer EMI aboard aircraft was discussed at last May's Executive Committee meeting of the Radio Technical Commission for Aeronautics (RTCA). Aeronautic Radio Inc. (ARINC), based in Annapolis, MD, has been looking into the issue and weighing the possibility of asking RTCA to set up a special committee to review the need for formal rules. No action has yet been taken however, because, as ARINC's Richard Climie explained to *Microwave News*, "We do not know of any substantiated cases of computers or any other devices causing an [EMI] problem." Climie said that he had heard of some incidents, but they could not be verified. RTCA action is on hold until concrete data are in hand.

Power Lines & Railroads

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

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

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

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

Industrial Machinery

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

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

Medical Devices

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

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

Naval Weapons Systems

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

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

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

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

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HIGHLIGHTS

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

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

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

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

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

These revisions described in "Changes in Microwave Radiation Exposure Standards" are codified in *Amendment No. 1 of 1/1/82 to State Standard 12.1.006-76 "Electromagnetic Radiofrequency Fields: General Safety Requirements."* These changes are in agreement with reports by US scientists who visited the USSR last year (see *MWN*, November 1982).

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

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

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

The present RF/MW standard for the general population is 5 uW/cm^2. Shandala did not disclose what the new standard might be, nor is it clear when the new standard will be promulgated. He did send *Microwave News* some comments on standard setting in the USSR (see "From the Field" p.12).

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

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

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

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

NY Power Lines Project To Fund Two Epidemiological Studies

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

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

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

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

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

FCC Inquiry on RF Lighting

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

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

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

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

Under current FCC rules, RF lighting devices are covered under Part 18, Subpart H. The commission believes that these rules were not designed to apply to mass produced consumer goods, and that they are not sufficently strict to prevent objectionable RFI. FCC test data indicate that RF bulbs can meet much tighter limits, similar to those controlling computer emissions (Part 15).

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

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

Massachusetts Adopts RF/MW Standard; Town Rule Overturned

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

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

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

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

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

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

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

FCC Test Methods for Computer RFI Simplified

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

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

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

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

Among the clarifications and revisions in the recommended test procedures:

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

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

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

NRPB Reports on RF/MW Sources and Standards

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

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

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

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

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

The occupational limits are identical to those adopted by

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

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

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

The NRPB also states that exposures to power line frequency (50 Hz in the UK) fields of less than 10 kV/m are "safe although the field may be perceptible at lower values." In addition, the board advises that exposures to fields as high as 30 kV/m are "unlikely to be harmful."

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

CONFERENCES

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

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

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

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

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

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

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

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

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

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

November 16-17: ***JINA 83,*** (2emes Journees Internationale de Nice sur les Antennes), Nice, France. Contact: J.L. Guiraud, Centre National d'Etudes des Telecommunications, Centre de La Turbie, 06320 Cap D'Ail, France.

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

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

1984

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

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

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

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

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

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

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

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

UPDATES

BIOLOGICAL EFFECTS

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

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

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

COMPATIBILITY & INTERFERENCE

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

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

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

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

GOVERNMENT

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

MEASUREMENT

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

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

MEDICAL APPLICATIONS

Hyperthermia Operator Safety... Operators of the Magnetrode hyperthermia unit who stay more than 1 meter away from the device will not be exposed to radiation levels in excess of the ANSI safety recommendations (4.9 mW/cm^2), according to a report in the July 1983 *Health Physics*. The Magnetrode unit, which operates at 13.56 MHz with an output power of up to 1,000 watts, is used in cancer therapy. M.A. Stuchly, M.H. Repacholi and D.W. Lecuyer ran tests using human-scale phantoms placed inside the Magnetrode's whole body electrode. The minimum safety distance is 2 meters under the Canadian safety code (1 mW/cm^2). They found smaller minimum distances at lower than a 1,000 W power setting, as well as when the unit's neck or thigh electrodes are used. The researchers from the Canadian Radiation Protection Bureau show that magnetic field strengths near the unit are consistently higher than electric field strengths. "To assess whether exposure to the operator is within the recommended limits, it is sufficient to examine the intensities of the magnetic field," they report.

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

MILITARY SYSTEMS

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

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

POWER LINES

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

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

STANDARDS

Toward a Population RF/MW Guidance...A special panel of EPA's Scientific Advisory Board (SAB) will meet September 22-23 in Washington, DC, for the first public review of the agency's draft report on RF/MW bioeffects. The report will be the basis of EPA's general population exposure guidance (see *MWN*, July/August 1983). The meeting will start at 9:15 AM in Room 2123 at EPA headquarters, 401 M Street, SW. Those wishing to present comments should contact SAB's Dr. Terry Yosie at (202) 382-4126 or Dr. Douglas Seba at (202) 382-2552. To meet a greater than anticipated demand, EPA has printed more copies of its report, *Biological Effects of Radiofrequency Radiation*, No. EPA-600/8-83-026A, which is available from the Center for Environmental Research Information, EPA, Cincinnati, OH 45268, (513) 684-7562....Dr. Daniel Cahill, who preceded Dr. Joe Elder as head of the Experimental Biology Division at EPA's Health Research Lab, has suggested setting an interim federal RF/MW exposure guidance for the general public that is five times lower than ANSI's 1982 revised levels and identical to Massachussetts' recently adopted standard (see story on p.5). In an article appearing in the July *Health Physics*, Cahill concludes that, based on EPA's bioeffects literature review, a maximum specific absorption rate of 0.04 W/kg (equivalent to 200 uW/cm^2 for the 30-300 MHz band and higher for frequencies above and below this range) would provide a factor of ten safety margin against "potentially significant health effects —any increase in core temperature or activation of thermoregulatory response and the development of areas of localized temperature elevations." He warns, however, that the proposed standard "does not mean that further research is not needed, particulary in the areas of mechanisms and frequency-specific and modulation effects." Cahill did not consider these factors because, "The evidence to support [their existence] is too incomplete at this time to influence exposure guidelines." His proposal is based on the assumption that the public is primarily exposed to continous wave radiation in the far field. Cahill left EPA in late 1981 to work at Carolina Power and Light's Harris Energy and Environment Center in New Hill, NC. Opinions presented in the paper are Cahill's and are not official EPA policy.

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

VDTs

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

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

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

Eyes and Vision... What seems to be distorted color perception after hours of VDT work may be the result of a well-known psychological illusion known as the McCollough effect. A letter to the August 4 *New England Journal of Medicine* explains that one of the authors, an architect at Northwestern University, experienced "an unusual and vivid visual illusion" after several hours of VDT work. "Ordinary white letters and lines on a contrasting background appear to have a pink color," she and two of her colleagues at the university write. Plain white paper might appear to have a pink tint at its edges. The McCollough effect can last for weeks although it is believed to be harmless. Susan L. Greenwald, and Drs. Mark J. Greenwald and Randolph Blake caution that, "physicians should be aware of the phenomenon so as not to mistake it for a hysterical symptom or a manifestation of neurologic disease."...A study of VDT operators' vision commissioned by a manufacturer of ergonomic office furniture found "no direct relationship between serious temporary or permanent eye pathology and VDT use." Dr. Dennis Arinella, an ophthalmologist at the University of Massachusetts Medical Center at Worcester, studied 21 female VDT operators at Wright Line, Inc. All 21 spent at least 30 hours per week at terminals. Arinella and Lee White, Supervisor of Office Services for the company, conclude that minor, correctable problems do exist, "which appear to increase the incidence of eye strain, including lightly pigmented irises, minimal uncorrected refractive errors, mild muscle imbalance and decreased tear production." The study will be presented October 12 at the meeting of the Office Automation Management Association in Washington, DC....The American Optometric Association (AOA) has published *Vision and the VDT Operator,* a brochure offering "advice on how to make VDT work easier on the eyes." The AOA warns that "VDT use can aggravate moderate and more severe vision problems," and recommends a safety checklist to protect terminal user vision. The list includes annual eye examinations, lighting and glare control and 15-minute breaks every two hours.

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

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FROM THE FIELD

Letter from the Soviet Union

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

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

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

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

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

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

Professor Mikhael G. Shandala

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

SHORT COURSES

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

VDT Radiation: Focus on Flyback Pulses

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

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

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

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

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

The Pulse Waveform

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

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

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

(continued on p.10)

ELF Bioeffects Studies at BEMS

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

Blackman and the Earth's Magnetic Field

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

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

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

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

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

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

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

Smith and his colleagues at the University of Salford in England have shown that there are observable changes in dielectric permittivity and loss in biological systems under conditions of magnetic resonance in the Earth's natural field (see *MWN*, October 1983). Blackman has now extended Smith's work to a much more complex system, calcium efflux.

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

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

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

Winters's Tumor Cells

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

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

Winters reported that in ten experiments in which human colon cancer cells were exposed for 24 hours to an electric field of 300 mA/m^2 (rms) and a magnetic field of 1 gauss, the cells formed 5.6 times more colonies than controls. For magnetic fields alone, the proliferation rate was 5.2 times greater than controls, while for the electric field alone it was only 1.8 times greater. Similar though less pronounced effects were observed with breast and head/neck tumor cells: according to Winters, the growth rates in combined fields and in magnetic fields were statistically significant.

Winters, a cell biologist at the University of Texas Health Science Center in San Antonio, TX, also reported on an experiment with colon cells exposed to a 0.5 gauss magnetic field. The increase in tumor-associated cell surface antigens at 300 mA/m^2 and 0.5 gauss was smaller than the observed increase at 300 mA/m^2 and 1 gauss, though both were larger than the response of control cells.

After Winters's paper there were numerous hallway dis-

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

Navy's Second Monkey Study

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

At about two-and-a-half years of age, the male monkeys exposed from the age of one month began to gain weight faster than those in the control group. Divergence continued for about a year, at which time the difference in size stabilized. In the last six months of the 54-month exposure protocol, the divergence narrowed. The researchers also identified a trend toward higher testosterone levels among the exposed males as compared to controls.

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

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

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

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

Future Unclear for EPA RF/MW Guidance

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

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

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

EPA Administrator William Ruckelshaus received his first briefing on the guidance September 4, three months after the proposal was scheduled for publication. The proposed rules were completed on time but met stiff opposition from the Office of Policy Planning and Evaluation as soon as internal review began this spring.

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

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

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

NAS Uncertain About EMP Effects

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

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

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

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

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

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

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

Recommendations

Engineering Aspects

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

Statistical Aspects

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

Seatbelts On, Cigarettes Out and Computers Off?

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

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

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

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

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

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

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

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

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

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

Project ELF Study Continues Despite Court Ruling

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

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

The AIBS report committee is chaired by Dr. H.B. Graves of Pennsylvania State University. The other members, and their topic areas are: Dr. Ralph Smialowicz, hematopoietic and immune systems; Dr. Asher Sheppard, cellular and in vitro systems; Dr Neil Chernoff, growth/reproduction/development; Dr. David Savitz, human studies; Dr. Robert Lindberg, environmental biology; Dr. Thomas Tenforde, magnetic studies; and Dr. Lionel Jaffee, bone growth and fracture repair.

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

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

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

Wisconsin Drops Suit

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

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

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

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

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

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

Study Discounts Vernon, NJ Birth Defect Fears

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

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

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

Citizens Against the Tower (CAT), a group of Vernon residents opposing new broadcast facilities, disagrees. According to CAT spokeswoman Elise Kreindler, the study was too general to address the community's chief concern: potential clusters of birth defects in several Vernon neighborhoods, including an area close to RCA Americom's satcom station.

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

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

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

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

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

SHORT COURSES

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

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

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

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

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

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

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

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

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

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

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

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

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

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

UPDATES

BIOLOGICAL EFFECTS

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

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

COMPATIBILITY & INTERFERENCE

FCC Computer RFI Rules... On July 30, the FCC denied a petition filed by Glen Dash of Dash, Straus & Goodhue, Inc. in Boxborough, MA, requesting changes in the commission's measurement procedures for radiated emissions from computing devices. Soon after the FCC issued new test procedures (commonly known as MP-4) last summer (see *MWN,* September 1983), Dash asked for some additional revisions. Dash, who is both an engineer and a lawyer, wanted a testing requirement specifying that all interface cables be left unterminated — MP-4 requires that peripherals be connected to the host computer via interface cables. The FCC rejected this option, arguing that "it is more important to simulate the conditions of actual use..." and that it was too soon to make such a "major shift in measurement philosophy." Other proposals made by Dash on the positioning of the cables during testing were also rejected by the commission. CBEMA had opposed the Dash petition. In a telephone interview, Dash said that his petition was "nothing more than a suggestion to streamline the testing procedure." He went on to call the MP-4 revisions a "tremendous leap forward" and said his petition was simply "asking the commission to go one step further." In retrospect he added, "I should have simply written the FCC a letter."...Responding to another petition on the same day, the FCC denied CBS Inc. an exemption from the commission's computer rules (Part 15, Subpart J) for electronic and pipe organs used primarily by churches. The organs use digital electronics for tone generation and for the operation of the console in controlling such variables as volume. (Though CBS is best known as a broadcaster, it also is in the organ business.) The FCC noted that CBS did not submit any measurement data to support its case for an exemption and decided that there was no justification for the exemption, especially given what it called the "minimal" requirements of its *verification* rules. The FCC concluded: "We believe that it is important for manufacturers to be made aware that digital electronic circuitry is capable of emitting considerable levels of radio noise which should be properly considered and controlled at the design stage."

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

INTERNATIONAL

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

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

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

MEETINGS

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

Call for Papers... The *17th Annual Meeting of the Conference of Radiation Control Program Directors* in Milwaukee, WI, May 19-23. Contact: CRCPD, 71 Fountain Place, Frankfort, KY 40601, (502) 227-4543....The *1985 IEEE International Microwave Symposium* in St. Louis, MO, June 4-6. Contact: Stephen Honickman, STG Electrosystems, 720 Manchester, Suite 215, Ballwin, MO 63011....The *International Aerospace and Ground Conference on Lightning and Static Electricity,* in Paris, France, June 10-12. In the US, contact: Lawrence Walko, AFWAL/FIESL, Wright Patterson AFB, Dayton, OH 45433; others: Dr. Joseph Taillet, ONERA, BP 72, 92320 Chatillon, France....The *1985 International Symposium on Microwave Technology in Industrial Development – Brazil,* Campinas, Brazil, July 22-25. Contact: Attilio Jose Giarola, UNICAMP-CCPG (Reitoria), CP 1170, 13100 Campinas, SP, Brazil....The *1985 International Symposium on Electromagnetic Compatibility* in Wakefield, MA (near Boston), August 20-22. Contact: Dr. Donald Weiner, Department of Electrical and Computer Engineering, 111 Link Hall, Syracuse, NY 13210.

MILITARY SYSTEMS

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

OCCUPATIONAL HEALTH

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

PEOPLE

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

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

STANDARDS

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

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

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

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

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

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

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

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

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

Guy's Data

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

Guy also measured the electric fields produced by flybacks. These were in the form of 10 usec wide pulses separated by 50-70 usec intervals. The peak amplitudes were approximately five times greater than the average. "For typical VDTs, the peak electric field levels may be as high as several thousand volts per meter [V/m] at the surface of the unit nearest the flyback transformer and near 10 V/m at 25-30 cm from the screen," Guy wrote in the abstract of his conference paper. He noted some significant exceptions, however: "these values can be ten to twenty-five times greater for some older models."

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

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

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

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

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

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

EPA Measurements

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

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

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

Delgado did not publish the time rates of change for his

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

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

Ontario Hydro and FDA

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

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

Walsh and Harvey measured the magnetic fields along three orthogonal axes near the VDTs. Along one of these, Murray noted, the waveform was very complex.

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

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

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

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

CONFERENCES

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

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

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

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

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

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

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

October 22-23: **International Conference on Microwave Tubes in Systems: Problems and Prospects,** London, England. Contact: Institution of Electrical Engineers, Savoy Place, London WC2R 0BL, England, (01) 240-1871, ext. 222.

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

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

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

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

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

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

FROM THE FIELD

University of Washington on Microwave-Cancer Study

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

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

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

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

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

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

1. There was some evidence of altered immune function, based on 10 exposed and 10 control animals sacrificed midway through the experiment, though this was not seen in animals sacrificed at the end of the experiment.

2. There was a suggestion of an increase in the weight of the adrenal glands in the exposed group, based on 10 exposed and 10 control animals sacrificed at the end of the experiment; however, this was not seen in animals sacrificed midway through the experiment.

3. There was a possible increase in the number of exposed animals with malignant tumors, which occurred in 16 of 100 animals in the microwave group and 4 of 100 control animals.

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

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

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Books from San Francisco Press

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

VDT Health and Safety Publications

VDT News offers bimonthly news reports on the latest developments for $35.00 a year. Our *VDTs: 1983 Health and Safety Update* ($7.50) summarizes the important news from last year in thorough detail. And our booklet, *VDTs: Health and Safety*, ($6.95) covers 1981-1982 and is an important resource for anyone concerned about VDTs. Orders must be prepaid and sent to: *VDT News*, PO Box 1799, Grand Central Station, New York, NY 10163.

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

Massachusetts To Propose 200 uW/cm² Population Standard

The state of Massachusetts will soon propose one of the most stringent general population standards for radiofrequency and microwave (RF/MW) radiation in the country. If adopted as drafted, the frequency dependent standard will be 200 uW/cm² in the 30–300 MHz band, rising to a maximum of 1 mW/cm² for frequencies above 1500 MHz and to 20 mW/cm² for those below 3 MHz. An occupational exposure standard identical to the new American National Standards Institute (ANSI) RF/MW standard will also be proposed. Both standards cover the 300 kHz to 100 GHz spectrum.

Robert Watkins, a radiation scientist with the Massachusetts Department of Public Health, said that the proposal had been developed in response to growing public fears over RF/MW radiation sources, especially antenna farms and the PAVE PAWS radar on Cape Cod. "Municipalities were beginning to set their own standards," he added, "so we decided to act."

While 26 states have enabling legislation to set RF/MW standards, only Texas has a regulation applicable to population exposures—a flat or frequency independent, 10 mW/cm² standard. In 1980, Portland, OR, became the first city to adopt an RF/MW exposure standard: 100 uW/cm² between 30 and 300 MHz and 500 uW/cm² otherwise. And in 1978, New York City's Bureau for Radiation Control proposed a flat standard of 50 uW/cm², which is still pending.

The Massachusetts proposal is now circulating among microwave experts for comment. The state's radiation program office will study their recommendations and issue a revised draft by April 1. A public hearing is scheduled for

(continued p. 8)

RFI at TMI

Portable Radio Confuses Gas Monitor

Workers with two-way radios resurrected fears that combustible gases were accumulating inside the Three Mile Island (TMI) nuclear plant in Middletown, PA. The No. 2 reactor was on alert for eight and a half hours on February 19–20, until TMI officials unraveled what turned out to be a series of equipment and operator errors, including radio frequency interference (RFI) with a gas measuring meter. In March 1979, the plant was crippled in a major accident; at that time there was widespread fear—later judged groundless—that a bubble of hydrogen gas inside the reactor would explode.

In the course of current preparations for a decontamination experiment, the crew found oxygen levels in the reactor building to be below normal. A couple of hours later they returned with a second gas meter that indicated abnormally high levels of combustible gases—hydrogen and hydrocarbons. The workmen also took an air sample for analysis. Gas chromatography of that sample confirmed that the hydrogen level was too high.

Later investigations showed that the oxygen meter had malfunctioned, that

(continued p. 8)

INTERNATIONAL REPORT

WHO RF/MW Criteria Document

The World Health Organization (WHO) recently published a criteria document on radiofrequency and microwave (RF/MW) radiation (100 kHz–300 GHz). It concludes that continuous occupational exposures in the range from 0.1 to 1 mW/cm² are safe and that population exposures should be kept "as low as readily achievable," at levels generally lower than those for occupational exposure. The full text of the WHO recommendations (Section 1.2) is reproduced below.

The 134-page report, *Environmental Health Criteria 16: Radiofrequency and Microwave Radiation,* was developed by a working group set up by the WHO and the International Radiation Protection Association. Dr. Moris Shore of the US Bureau of Radiological Health was the chairman of the committee, whose other members were Dr. V. Akimenko, USSR; Professor P. Czerski, Poland; Mme. A. Duchene, France; Dr. M. Faber, Denmark; Professor M. Grandolfo, Italy; Mr. F. Harlen, England; Dr. H. Jammet, France; Dr. J. Kupfer, German Democratic Republic; Dr. M. Repacholi, Canada; and Dr. B. Servantie, France.

The text includes reviews and summary tables of bioeffects research and of various exposure standards. Among the other topics are sources of radiation, conditions of exposure, measuring instruments, radiation absorption in biological systems and safety procedures for occupationally exposed personnel. The document contains a bibliography of more than 300 references and a nine-page glossary.

The report is available in the US from: WHO Publications Center USA, 49 Sheridan Avenue, Albany, NY 12210. Elsewhere, contact the nearest WHO regional office or write to WHO, Distribution and Sales Service, 1211 Geneva, 27, Switzerland.

Recommendations for Further Studies, Exposure Limits, and Protective Measures

General recommendations

The basic biophysical mechanisms of interaction of microwaves and RF with living systems still need clarification and further studies.

Work on both theoretical and experimental dosimetry, the calculation and measurement of fields and of energy deposited within simulated or actual biological systems, should be continued and refined.

Results of animal studies are difficult to extrapolate to man, and these studies alone do not constitute a satisfactory basis for the establishment of health protection criteria. They should, therefore, be supplemented by appropriate epidemiological studies in man.

The existing data on power, amplitude, and frequency "windows" seem to warrant continued investigations.

The effects of chronic exposure on sensitivity to convulsant and other drugs are potentially useful and may have a direct bearing on the development of exposure standards.

Long-term, low-level exposures combined with such stresses as high ambient temperature and humidity should be investigated.

There is little published information on dose-effect relationships; reports tend to be limited to whether effects are observed at one particular level of exposure rather than over a range. More dose-related information, even covering small subject areas, would be valuable.

Investigations on the genetic effects and effects on development of microwave and RF radiation should have priority.

Attention should be given to investigating the different sensitivities to microwave/RF exposure of subgroups within the general population.

National and international agreements on exposure limits, ways and means of controlling this type of environmental pollution, and concerted efforts to implement such agreements are needed.

Measurement techniques

There is a continuing need for the development of microwave/RF measuring instruments that: (*a*) give direct readings of electric or magnetic field strength, or power density; (*b*) are robust; (*c*) are portable, light-weight, and battery-operated; and (*d*) are sensitive and can be used over a wide frequency range.

The problem of the design of personal dosimeters also remains to be solved.

Safety procedures

Computation techniques or methods that predict the distribution of fields close to deliberate high-power emitters (in the near field) are needed.

Emphasis should be placed on the development of technology to ensure containment and limitation of radiation to the deliberately exposed object, as well as the reduction of leakage emission from devices.

Personal protection devices should be used only as a last resort.

Adequate medical surveillance of occupationally-exposed persons should be provided.

Once exposure limits have been set, safety guidelines or codes of practice concerning safe use and installation design should be developed as soon as possible.

Biological investigations

Reports of experimental work should contain sufficient information describing the exposure conditions to allow an estimation not only of the total absorbed energy but also, as far as possible, of the distribution of the energy deposited within the irradiated biological system.

Systematic investigation of the effects of microwave/RF exposure at all levels of biological organization are to be encouraged. This includes effects at the molecular level on subcellular components; cells, viruses, and bacteria; organs and tissues; and whole animals. Particular attention should be paid to: (*a*) long-term, low-level exposures and possible delayed effects; (*b*) the possibility of differences in sensitivity of various body organs and systems, where specific effects in various animal species are being considered; and (*c*) the influence of microwave/RF exposure on the course of various diseases, including any possible increase in sensitivity to microwaves/RF that may result because of the disease state.

Epidemiological investigations

Epidemiological studies should be carried out in a careful manner, paying attention to the relationship between exposure to microwaves/ RF and other environmental factors occurring in the place of work and to the health status of the investigated group. Specific biological endpoints should be selected and adequate examination methods used for such studies. Conventional medical examinations will not provide sufficient information.

Studies should be carried out on (*a*) workers occupationally

exposed to microwave/RF sources; (*b*) patients treated with microwave and RF diathermy; and (*c*) groups within the general population living near high-power microwave/RF sources.

A distinction should be made between occupational and public health protection standards.

Exposure limits and emission standards

Occupational exposure limits: The occupationally-exposed population consists of healthy adults exposed under controlled conditions, who are aware of the occupational risk. The exposure of this population should be monitored.

It is possible to indicate exposure limits from available information on biological effects, health effects, and risk evaluation. For occupational exposure, values within the range 0.1–1 mW/cm^2 include a high enough safety factor to allow continuous exposure to any part of the frequency range over the whole working day. Higher exposures may be permissible over part of the frequency range and for intermittent or occasional exposures. Special considerations may be indicated in the case of pregnant women.

Exposure limits for the general population: The general population includes persons of different age groups and different states of health, including pregnant women. The possibility that the developing fetus could be particularly susceptible to microwave/RF exposure deserves special consideration.

Exposure of the general population should be kept as low as readily achievable and exposure limits should generally be lower than those for occupational exposure.

Emission standards: Emission standards for equipment should be derived from, and be lower than, exposure limits where this can reasonably be achieved. A class of equipment may be considered safe and exempt from regulations, if hazardous levels of radiation exposure cannot originate from such a source.

Implementation of standards: The implementation of microwave and RF occupational and public health protection standards necessitates: the allocation of responsibility for measurements of radiation intensity and interpretation of results; and the establishment of detailed radiation protection safety codes and guides for safe use, which indicate, where appropriate, ways and means of reducing exposure.

Other protective measures: Prevention of health hazards related to microwave and RF radiation also necessitates the establishment of rules for the prevention of interference with medical electronic equipment and devices such as cardiac pacemakers, prevention of detonation of electroexplosive devices, and prevention of fires and explosions due to the ignition of flammable material (vapours) by sparks originating from induced fields.

Studies related to the establishment of limits: Studies of the frequency and modulation dependence of biological and health effects are of prime importance. The results of such investigations may make it possible to modify the rationales of present day standards and to identify frequencies at which exposure limits should be lower or higher than those suggested in section 11.

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Letter From China

Microwave News *has received the following report from the Peoples' Republic of China on two recent microwave bioeffects courses sponsored by the China Microwave Institute in Beijing. We thank Shen Zhi-yuan, a visiting scientist at the Polytechnic Institute of New York, for providing this translation of the original text.*

Two short courses on microwave biological effects sponsored by the China Microwave Institute were held in Shanghai (August 1981) and Chengdu (January 1982). The attendees, numbering 241 in Shanghai and 83 in Chengdu, came from all around the country except for Tibet and Taiwan. Among them were professors and lecturers from universities and colleges, physiotherapists from hospitals, researchers from tumor research institutes, engineers and technicians from labor and environmental protection organizations.

The main topics of the courses were common microwave biological effects, the biological and medical applications of microwaves, and the fundamentals of microwave safety protection. The theoretical and clinical problems associated with local microwave thermotherapy for treating some kinds of malignant tumors and common diseases were also included.

China began developing microwave biological effects research for establishing a safety exposure standard of microwave radiation in 1974. Some health studies on the operators of microwave equipment in large cities have been completed.

Since 1978, active research on local microwave thermotherapy together with chemical and radio therapy for curing malignant tumors have been carried out at Beijing, Shanghai, Nanjing and Henan. The research items include: mechanisms of high temperature affecting cancer cells, optimum temperature, dosage and procedures for treatment, and methods for measuring temperature in microwave fields. Beneficial effects on some advanced cancer patients have been observed. In China, some researchers are trying to use local microwave thermotherapy for birth control.

Topics of Shanghai Short Course: 1. Prospects for microwave power applications. 2. Biological effects of microwaves. 3. Physical mechanisms of interactions between living systems and microwaves. 4. Microwave applications in biology and medicine. 5. Microwave thermotherapy for curing cancers. 6. Microwave effects on the human body. 7. A safety exposure standard for microwave radiation. 8. Safety protection from microwave radiation.

Topics of Chengdu Short Course: 1. Fundamentals of microwaves. 2. Biological effects of microwaves. 3. Techniques of microwave thermotherapy and cancer treatment. 4. Microwave local heating technique for male birth control. 5. Clinical microwave thermotherapy. 6. Microwave thermotherapy. 7. Agricultural applications of microwaves. 8. Temperature measurement in microwave fields. 9. Measurements of electromagnetic near field and leakage energy. 10. Principle, operations and maintenance of microwave therapeutic apparatus. 11. Safety exposure standard and protection of microwave radiation.

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HIGHLIGHTS

FCC To Consider RF/MW Hazards

The Federal Communications Commission (FCC) plans to address radiofrequency and microwave (RF/MW) radiation hazards under its environmental protection rules. Applications for facilities exposing workers or the public to radiation levels of more than 10 mW/cm^2 or exceeding any relevant emission standard would be added to the list of "major actions" requiring environmental assessment and possibly environmental impact statements.

The rules proposed on January 28 are the response to the FCC's 1979 notice of inquiry on radiation hazards (44 *Federal Register* 37008, June 25). The commission has decided that the National Environmental Policy Act (NEPA) "requires us to evaluate exposure of the public from the facilities we authorize" against potentially harmful radiation. Since no federal population exposure standards exist, the Occupational Safety and Health Administration's (OSHA) occupational guideline has been chosen as the gauge for public exposure "until such time as the appropriate federal agency issues standards." The only relevant and applicable emission level at this time is the Bureau of Radiological Health's new oven standard. The commission noted it had "neither the expertise nor the primary jurisdiction" to set safety levels.

The FCC has refused to become involved in the controversy over local and state exposure standards. In its notice of proposed rule making, the commission states it sees "no significant conflict" between these actions and its responsibility under the Communications Act to make available rapid and efficient communications.

Under the proposed rules, an applicant for a new RF/MW source would be required to point out potential radiation exposure and emission problems in a "narrative statement" submitted to the FCC. This report would trigger an evaluation process. After examining the report, the FCC staff could decide to prepare an environmental assessment for the project. If warranted, the commission would then proceed with an EIS. The rule would apply to applications for equipment authorization, construction permits and licenses to transmit.

The commission anticipates the new rules will affect very few RF/MW sources. Most applicants would be in compliance with the OSHA standard and "thus should be categorically excluded" from the requirements. Currently operating facilities and equipment licensed by the FCC would not be reevaluated.

Commenting on the action, the FCC's Dr. Robert Cleveland and Deputy General Counsel Peggy Reed said they did not expect the rules to result in many EIS's. In fact, since NEPA became law in 1970 the commission has prepared only one EIS and that was for a FM tower in a scenic area.

Comments on the proposed rule are due by June 18, and reply comments by August 18.

FY83 Budget Proposals

The President's budget has met with considerable resistance in Congress, and it will take some time before a compromise is reached. Who the winners and losers will be and how the changes will filter down to affect non-ionizing radiation programs is anything but clear. In fact, some agencies have yet to have their budgets for FY82, already in its sixth month, approved and are still operating on a continuing resolution. Apart from requests for specific applications, non-ionizing radiation programs are rarely line items in agency budgets. So the details that follow only give a rough indication of what will actually be appropriated and spent.

• *Bureau of Radiological Health:* BRH is still operating on a continuing resolution, so its planning staff was hesitant to discuss FY83 while FY82 is still unsettled. FDA's radiological products line item, which includes ionizing and non-ionizing radiation programs, has been increased by $946,000, but the equivalent of six staff positions have been eliminated. One indication of hard times is the announcement that the *BRH Bulletin* may cease publication next month unless OMB gives its approval for the expenditure.

• *Department of Defense:* $72.7 million for PAVE PAWS, of which $69.4 million is for procurement at the SE site at Robins AFB, GA; $31.3 million for the PAVE MOVER program; $79.1 million for over-the-horizon radar; $79.8 million for the military satellite program; $10 million for EMP work ($3 million for Kirtland AFB and $7 million for RDT&E); $49.8 million for Project ELF (see opposite page).

• *Environmental Protection Agency:* The agency's radiation (ionizing and non-ionizing) program was cut by $27,000 and the equivalent of 14 staffers. EPA's Dave Janes said it was too early to judge the impact on non-ionizing radiation work. While research and development was cut by over $45 million to $108.7 million, EPA's budget report did note that the radiation program "will focus on evaluating health effects information needed for establishment" of a general population guidance.

• *Federal Communications Commission:* The FCC's budget was cut by $2.9 million from its $77.3 million FY82 continuing resolution budget.

• *National Aeronautics and Space Administration:* NASA's 30/20 GHz satcom program has no funds to build a prototype satellite or to start a flight program. About $5.1 million is slated for completing the development process.

• *National Bureau of Standards:* NBS's budget of $104 million is about equal with last year's request if one discounts the transfer of the computer institute from NBS to GSA.

• *National Institute for Occupational Safety and Health:* NIOSH is also on continuing resolution. The FY83 proposal is for $50.5 million, down from $56 million requested for FY82—which is itself much lower than the House or Senate proposals. One major point here is whether the NIOSH budget bill will bar the use of funds to move the agency down to Atlanta (see updates).

• *National Telecommunications and Information Administration:* NTIA's budget was cut by $4 million to $12.4 million for FY83. Most of the cut is in the policy division and administrative support. The agency's satellite program was eliminated.

• *Occupational Safety and Health Administration:* OSHA's budget was increased by about $14 million over the amount allocated in its continuing resolution. OSHA is planning to make 53,000 inspections in FY83, compared to 52,000 projected for FY82.

NIOSH Criteria Document Nears Completion

The National Institute for Occupational Safety and Health (NIOSH) criteria document on radiofrequency and microwave (RF/MW) radiation will be ready for external review in the late spring. Speaking from Rockville, MD, Dr. Momtaz Wassef, NIOSH's project manager for the document, said that the NIOSH team was in the process of assigning SAR (specific absorption rate) values for the key papers in the literature and picking levels for the new proposed standard.

Sections of the document have already been reviewed by consultants selected by NIOSH. Listed below are the consultants and the biological effect they reviewed: Dr. Ernest Albert, George Washington University, central nervous system; Dr. Russell Carpenter, Bureau of Radiological Health, ocular; Dr. Ronald Jensh, Thomas Jefferson University, reproduction and teratology; Drs. Don Justesen and Virginia Wolf, VA Medical Center, Kansas City, behavioral; Dr. Robert Lebovitz, University of Texas, auditory; Dr. Robert Liburdy, USAF School of Aerospace Medicine, immunology and hematology; Dr. Shin-Tsu Lu, University of Rochester, cardiovascular; Dr. Sol Michaelson, University of Rochester, general physiology; and Dr. Vernon Riley, Hutchison Cancer Research Center, Seattle, neural and endocrine.

Canadian VDT Ruling: No Loss of Pay for Alternative Work During Pregnancy

A labor arbitration board in Ontario has ruled that a video display terminal (VDT) operator cannot be penalized for transferring to a non-VDT job during pregnancy. Helen Barss, a data processor at the Ministry of Education, filed a complaint last May after her request for alternative work during her last four months of pregnancy resulted in a temporary job demotion with a cut in pay. On January 21, a three-member Ontario Crown Employees' Grievance Settlement Board ruled that Barss must be compensated for the difference in salaries.

In its decision, the board wrote that Barss's "sole reason for making the request was the belief (we think on reasonable grounds) that the change should be made for the protection of her unborn child." Under the Crown Employees' Collective Bargaining Act, a worker is entitled to the same salary while reassigned to a lower paying job for up to six months if the change is for health reasons.

The board emphasized that it lacked "both the authority and the ability" to decide whether VDTs present a health hazard, though it judged Barss had legitimate reasons for her fear. The decision stated that people are entitled to be skeptical of scientists' conclusions and cited changing opinions about the safety of urea formaldehyde, DDT, 2,4-D, contraceptives and other products.

Barss asked to leave VDT work in her fifth month of pregnancy on the recommendation of her doctor. The ministry argued her job posed no health risks but agreed to transfer her for personal rather than health reasons. Barss worked as a records clerk for the remainder of her pregnancy at $267 per week rather than the $286 she regularly earned.

Electric Fields Heal Fractures

Dr. Andrew Bassett and his colleagues at the Columbia-Presbyterian Medical Center in New York City have concluded that the treatment of non-healing bone fractures with electric fields is safe and effective and that it could now be "the primary treatment for ununited fractures or arthrodeses."

According to their report published in the February 5 *Journal of the American Medical Association* (JAMA), pulsing electromagnetic field (PEMF) therapy has worked for over 77 percent of the 1078 patients treated in the US and abroad during the last seven years. The success rate was unaffected by the age of a patient's fracture, the number of operations prior to PEMF treatment or the presence of infection. No adverse side effects have been reported since the technique began trials at Columbia in 1974.

Bassett's system is non-invasive; coils are placed around the site of the fracture to generate PEMFs, which in turn penetrate the body and induce weak electric currents in the bone. Research at the center has shown that these fields modify cell behavior and promote bone growth.

An editorial accompanying the report in the *JAMA* praises the use of PEMFs and the related, but invasive, direct-current stimulation as "a major advance in traumatic orthopedic surgery." The author, Dr. Clinton Compere of Northwestern University Medical School in Chicago, IL, states that the consensus judgment must be that electric stimulation methods are effective.

In an answer to some critics who have asked for double-blind experiments (see *MWN*, May 1981), Bassett and his team argue, "When 75 percent or more of [the subset of patients disabled for more than two years], and in whom spontaneous healing is unlikely, are healed by PEMFs, there is little room for rational doubt that the method is highly effective."

Navy Issues Project ELF Plan

The Naval Electronic Systems Command has released a work plan for its ELF submarine communications system. The 34-page, illustrated report, *Extremely Low Frequency (ELF) Communications Program in Wisconsin and Michigan; System and Site Definition, Program Plans, Environmental Summary and Supplementary Information,* December 1981, details the schedule for making the system operational by 1986.

The Wisconsin facility at Clam Lake will be upgraded; new transmitting equipment will be installed by 1984. The existing overhead antenna operating with a current of 300 amperes will stay in use. The navy will build two additional antennas in Michigan, each 28 miles long and mounted on poles, at a site still to be determined. When completed, these will carry a current of 150 amperes and operate synchronously with the 28-mile Wisconsin antenna. The Michigan control center will be located at K.I. Sawyer AFB.

The proposed FY83 budget allocates $49.8 million for Project ELF, of which $32.3 million is for new equipment in Wisconsin and Michigan.

The navy will issue an environmental protection plan and a draft ecological monitoring program for the Michigan site later this year. The IIT Research Institute (IITRI), which is managing this work for the navy, is now in the process of soliciting proposals for relevant environmental studies. A bidder's conference is scheduled for March 18 at IITRI's main office in Chicago, IL. Although the work plan indicates that the navy does not intend to carry out any ecological studies in Wisconsin, IITRI's Marty Abromavage told *Microwave News* that this decision has been reviewed and that some studies may now be funded if they are judged worthwhile. The navy has budgeted $750,000 for ELF ecological studies in FY82 and has proposed to spend $2 million on them in FY83.

The navy intends to protect power and telephone lines against interference in both states and will pay for any mitigation costs.

The report drew criticism from Stop Project ELF (SPE), a group based in Madison, WI. In written comments submitted by SPE, Jennifer Speicher and John Stauber claimed that the navy had reneged on its 1969 commitment to remove the Clam Lake facility once testing had been completed. SPE urged the navy to prepare an environmental impact statement for the Wisconsin site that included analyses of possible interference with airplane equipment and potential effects on the weather.

Copies of past environmental impact statements for Project Sanguine and Seafarer, the previous names of the ELF system, are available from the Environmental Law Institute, 1346 Connecticut Avenue, NW, Suite 600, Washington, DC 20036, at a cost of ten cents per page.

UPDATES

Biological Effects....Some professors at Virginia Commonwealth University's Department of Pharmacology and Microbiology have set up a consulting firm called Quintox and have won a contract from the Office of Naval Research (ONR) to work on drug-microwave synergy. Professor Albert Munson will head the study of synergistic effects of microwaves and amphetamines on the immune system. VCU's Professor Stephen Cleary will serve as a consultant on the project. The first year's award is for $75,000; the project will run for two or three years....Drs. Przemyslaw Czerski and Ewa Manikowska have detected chromosomal abnormalities, cell degeneration and cell death in spermatogenic cells of mice exposed to 0.915, 2.45 and 9.4 GHz microwaves. A full description of this new research from BRH will appear in next month's issue....The workshop on *Behavioral Effects of Microwave Radiation Absorption,* reported as tentatively scheduled in last month's issue, will be held March 16–19 outside Salt Lake City as planned. For more information contact: Professor John D'Andrea at the University of Utah, (801) 581-8590....BRH is seeking a contractor to study the electromagnetic absorption characteristics of biological and simulated biological materials. For more information contact David Ramos at the FDA, (301) 443-4420....A US-Canadian team reports on the measurement of the permittivity of biological tissue with an open-ended coaxial cable in the January *IEEE Transactions on Microwave Theory and Techniques* (p. 82). ...Dr. James Bond of Jaycor in Alexandria, VA, is scheduled to present a seminar on "A Physiochemical Basis for Alterations in Ca Efflux from Cerebral Tissue Exposed to Low Intensity RF Electromagnetic Fields," on March 2 as part of ONR's Washington, DC-area seminar series.

Communications....The Office of Technology Assessment (OTA) has issued a report, *Radiofrequency Use and Management: Impacts From the World Administrative Radio Conference of 1979,* which concluded that the US "must begin to develop policies now that will assure that international telecommunication decisions do not jeopardize its political, economic and national security interests." Free summary copies are available from OTA, US Congress, Washington, DC 20510, (202) 224-8996. Or you can order a complete copy from the Government Printing Office, stock no. 052-003-00863-7, $6.50.... Microband Corp. of America, a subsidiary of Tymshare, wants to clear the way for over-the-air delivery of pay TV and other information services in 50 US markets. The company is seeking FCC approval to use multipoint distribution service (MDS) for multichannel systems capable of competing with cable TV. Microband calls its proposed 5-channel system Urbanet....The FCC has approved the first equipment for the Digital Termination Service (DTS). (See *MWN,* October 1981.) Rapac, a radio to transmit digital data within cities, will be available from Local Digital Distribution Co. of Rockville, MD, this summer. The company is a joint venture of M/A-COM Inc. and Aetna Life and Casualty Co....Megapulse Inc. of Bedford, MA, has been awarded $350,000 to perform a radio propagation study for DOE, and GE will do a $396,000 study of "mobile radio alternative systems" for NASA.

Compatibility and Interference....The new word processors at the State Department are emitting signals that are disrupting the clocks around the offices, according to an item in the February 5 *Washington Post.* The interference has yet to be controlled....The Lawrence Berkeley Laboratory (LBL) is hosting a two-day conference on *Lighting-Electromagnetic Compatibility* on March 18–19. The focus of the seminar will be the conducted and radiated EM waves from lighting systems operating at high frequencies. LBL will publish the proceedings of the meeting. For more information contact: Rudy Verderber, Room 90-3111, LBL, University of California, Berkeley, CA 94720, (415) 486-5605....The first issue of a new quarterly, *EMC Technology,* appeared in January. The magazine is published by Don White Consultants of Gainesville, VA. Subscriptions are $20 a year. Contact: Circulation Director, *EMC Technology,* PO Box D, Gainesville, VA 22065....Don White Consultants will be running a 4-day course on EMI/EMC grounding and shielding for the Bonneville Power Administration....And the navy has hired A&T Technical Services, Inc., for support in improving EMI/EMC communications. The contract is worth about $1.1 million....The International Special Committee on Radio Interference (CISPR) of the International Electrotechnical Commission has published the third edition of its publication (no. 10) *Organization, Rules and Procedures of the CISPR.* It is available from: Bureau Central de la Commission Electrotechnique Internationale, 1 rue de Varembe, Geneva, Switzerland. The price is 41 Swiss francs....CBS and NBC want the FCC to reconsider its recent decision to allow the Field Operations Bureau to shut down interfering news-gathering equipment. (See *MWN,* January/February 1982.) In its petition, NBC notes that the interference during the first shuttle flight—the impetus for the rule—was caused by out-of-band harmonics from the equipment, even though it was operating well within applicable FCC specifications. NBC states that the rules "address a theoretical situation that...has never occurred." The broadcasters argue that the rules are too broad and unnecessary....The National Association of Broadcasters (NAB) has begun a program of tracking the frequency and power used by Cuban stations, which are interfering with US radio broadcasters. The NAB will use the data to show the urgency of the problem....A group from the naval Research Laboratory in Washington, DC, has measured the spectral noise density, amplitude probability distribution and spectral content of ambient noise from 1.0 to 4.0 kHz at sites in Italy and Norway. The results appear in the January/February *Radio Science.*

Measurement....NBS will host this year's *Conference on Precision Electromagnetic Measurements* in Boulder, CO, June 28–July 1. For more information contact: David W. Allan, CPEM '82, NBS, 325 Broadway, Boulder, CO 80303....Canada's Douglas Hill has developed a new way to calibrate miniature probes used to measure electric fields in biological tissues at 2.45 GHz. His description is in the January *IEEE Transactions on Microwave Theory and Techniques.* ...And a team from McGill University in Montreal has published a set of design criteria for absorber-lined chambers used in electromagnetic susceptibility measurements in the February *IEEE Transactions on Electromagnetic Compatibility*....The Naval Surface Weapons Center in Dahlgren, VA, is seeking comments from contractors interested in developing a new and more compact RF/MW hazard meter for use aboard ship.

Medical Applications....Phosphorus-31 NMR has been used to observe the energy metabolism of human muscle. A team from England, G.K. Radda *et al.,* reports in the February 18 *Nature* (p. 608) that they have used the technique to measure changes in phosphocreatine and pH during exercise of the forearm of persons with muscular disorders....Two new review articles on the application of NMR were published last month. The potential for imaging and in vivo spectroscopy is reviewed in the February 5 *Science* (p. 619) and a more intro-

ductory piece appears in the January/February *Technology* (p. 32). ...Dr. Richard Heilman of the University of Vermont College of Medicine argues that there is a paradox in the presence of a malaise surrounding imaging technology at a time of its greatest development. In an editorial in the February 25 *New England Journal of Medicine*, *"What's Wrong with Radiology?" he explains the* paradox in terms of an inability to develop a coherent delivery system....M&D Technology Ltd. will start manufacturing NMR imagers in Aberdeen, Scotland. The university's Professor John Mallard will serve as the new company's scientific director....The January 28 *New Scientist* features an article on bioelectricity, "The Electricity That Shapes Our Ends."...RF, microwave and ultrasound hyperthermia for cancer treatment will be the subject of one of the sessions at the *Tenth Annual Northeast Bioengineering Conference* to be held at Dartmouth College, March 15–16. Dartmouth's Dr. Evan Douple will give a keynote speech on hyperthermia....The Association for the Advancement of Medical Instrumentation is holding its annual meeting in San Francisco, May 9–12. Among the sessions are those on hyperthermia cancer therapy, NMR imaging and medical device regulation. For more information, contact: AAMI, 1901 North Myer Drive, Arlington, VA 22209, (703) 525-4890.

Military Systems....The air force has decided to expand its experimental over-the-horizon backscatter radar system in Maine to cover a 60 degree sector as the next step in its development. The AF's Electronic System Command at Hanscom AFB, MA, is in charge of the work at the two OTH-B radar sites in Moscow/Caratunk and Columbia Falls, ME. A decision on where to site the full scale system will be made in the next few months. Bangor International Airport is the leading choice....The Naval Surface Weapons Center in Dahlgren, VA, wants to develop a compact, lightweight receiver with a frequency range from 200 Hz to 100 kHz for use on ships and aircraft (*Commerce Business Daily,* February 10).

Occupational Health....There is a good chance that OSHA will delete all of its "should" or voluntary standards in the coming months. This would eliminate the 10 mW/cm^2 guideline now on the books, and would make it possible to cite RF/MW violators under the OSHAct's general duty clause—possibly for exceeding the new, more stringent ANSI standard....Will NIOSH move to Atlanta or will its director, Dr. J. Donald Millar, come north to Rockville, MD? The drama continues. (See *MWN,* July/August & September 1981.) Congressman David Obey (D-WI) is again pressuring Millar to join the NIOSH staff in the Washington, DC, area. The subject will be aired at House appropriations hearings scheduled for February 25....OSHA is working with the American Electronics Association (AEA), based in Palo Alto, CA, to develop an occupational health and safety program for the more than one million workers in the electronics industry. The agreement calls for the project to start April 1 and to expire September 30 unless renewed....Meanwhile OSHA is closing down 41 of its area offices and laying off some 300 staff members. The agency has also changed its inspection policy so that only those work places which threaten "physical harm or an imminent danger" will be inspected....The American Industrial Hygiene Conference, scheduled for June 6–11 in Cincinnati, OH, will feature papers on non-ionizing radiation.

Ovens....Factory shipments of microwave ovens dropped 16% in January compared to last year. According to the latest statistics compiled by the Association of Home Appliance Manufacturers, 304,100 ovens were produced or imported, down from 361,900 in January 1981. Shipments of all major appliances declined 24%....Cober Electronics has published a new four-page brochure describing continuous microwave vulcanization ovens and pre-heaters developed *specifically for rubber processors. For a free copy, contact: Cober,* 102 Hamilton Avenue, Stamford, CT 06902.

People....RCA's Howard Johnson will be retiring on April 1 after 35 years with the company. He will be resigning as secretary of IMPI but will serve out his term on TEPRSSC. Johnson said that he might do some consulting. It is not clear if anyone will follow RF/MW issues for RCA when Johnson is gone....Verle Blaha has retired from Litton Microwave and become general manager and vice-president of Holaday Industries in Eden Prairie, MN....Sidney Metzger, a member of FMAC, has retired as chief scientist of Comsat. The company has yet to announce who will replace him....Dan Lynch, vice president of Executive Consultants Inc., has become the new executive director of IMPI. The institute recently moved its office from New York City to Vienna, VA.

Power Lines....The New York State Overhead Power Lines Project's Advisory Panel met in New York City over the February 19 weekend to select the winning proposals for studies on the health effects of powerline radiation. Some 15–20 projects will receive $3.5 million. A decision is due by April 1. At a public meeting held during the deliberations, panel chairman Dr. Michael Shelanski of NYU said that "due to funding limitations and the state of the art, the research funded under the program will not yield definitive answers on risk, but will give clear-cut replicable results." The state's Dr. David Carpenter revealed that the project will hire a consultant on dosimetry, who will visit all the funded labs. NYU's Dr. Arthur Upton has resigned from the panel for personal reasons.

Satellite Communications....The House Committee on Government Operations has recommended a study be prepared on potential applications of direct broadcast satellites (DBS). Both its report, *International Shortwave Broadcasting and Direct Broadcast Satellites: Voice of America, Radio Free Europe/Radio Liberty, Radio Marti,* December 11, No. 97-398, and the hearing record upon which it is based, *International Broadcasting: Direct Broadcasting Satellites,* are now available from the committee....The FCC is expected to authorize as many as eight interim DBS systems this spring. It decided against reconsidering two rejected DBS applications at a February 18 meeting....Meanwhile, Comsat's Satellite Television Corp. (STC) is gearing up to open a three-channel direct-to-home pay TV service in 1985. A special report on STC appears in the February 22 *Broadcasting*....Ford Aerospace and Communications wants to build one billion dollar's worth of satellites for Intelsat, but the international satcom group plans to negotiate the contract with Hughes Aircraft. This February Ford asked the FCC to block Comsat's participation in the construction project in order to prompt Intelsat to reconsider the bids....Despite the recent bad news, or perhaps because of it, Ford ran two-page ads in the *New York Times* and the *Washington Post* assuring readers "There's a Ford [satellite] in America's Future." ...AT&T has filed with the FCC to start a nationwide satellite distribution system for radio programs later this year....A review article on business use of satellite communications appears in the February 12 *Science*....The January *Microwave Systems News* offers a view of satcom's role in the 1980's....An interview with the army's Project Manager for Satellite Communications, Colonel Charles Lindberg, is featured in the January issue of *Military Electronics/Countermeasures*....RCA has come up with a new scheme for leasing transponders on its Satcom IV satellite since its November auction, bringing in a total of $90.1 million in winning bids, was invalidated by the FCC in January. The company has proposed selling each lease for $13 million, a price it says reflects market demand.

Standards....The National Associaton of Broadcasters has awarded Jane Clemmensen of the University of California, Berkeley a grant for a "Report on the Status of Federal Standards on Non-Ionizing Radiation."

Technology*....The National Oceanic and Atmospheric Administration* has awarded three $850,000 competitive contracts for designing a new weather-radar system to Raytheon, Sperry and a team from Ford Aerospace & Communications and Westinghouse Electric. The government hopes to replace 300 aging radar units with 160 new ones, capable of giving advanced warning of tornados and flash floods, by

the mid-1990's....The worldwide satellite remote sensing market will reach $400 million per year by 1990, according to a study by Metrics Inc. of Atlanta, GA. Metrics estimates this market is the fastest growing area of commercial space activity. For information contact: G. William Spann, Metrics Inc., 290 Interstate North, Suite 116, Atlanta, GA 30339, (404) 955-1975....The IEEE MTT Society has published *Low-Noise Microwave Transistors and Amplifiers,* a book of selected reprints. Cost: $16.95 paper for IEEE members, $33.95 hardcover or $25.45 for IEEE members. Order prepaid from the IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854....An article on the macron accelerator, a device that can accelerate gram-size pieces of matter to high speeds and a relative of the rail gun, appears in the January/February *American Scientist*....In contract news, the Defense Nuclear Agency is seeking a contractor to write guidelines for designing electronic circuits in such a way as to avoid electromagnetic pulse (EMP) damage. Contact Robert Henshaw, (202) 325-7658.... NASA is negotiating with NOVAR Electronics Corp. of Barberton, OH, for an evaluation of SPS sonic simulator development and microwave propagation effects....Texas Instruments Inc. of Dallas, TX, has won a $227,104 contract from the FAA to support the installation of MLS prototype ground equipment at Philadelphia International Airport....The Army Armament R&D Command is negotiating with Geo-Centers Inc. of Newton Upper Falls, MA, to evaluate the theoretical possibilities of microwave absorption for detecting chemicals....Yale University will perform experiments on the interaction of electromagnetic waves with metallic fibers under a $200,000 contract from the Army Research Office.

VDTs....Video display terminal (VDT) provisions in the new Newspaper Guild contract with the Montreal *Gazette* include shielding for the flyback transformers of all plastic bodied terminals (see *MWN,* March 1981), annual eye examinations and alternative work for pregnant operators upon request. If reassignment is impossible, a lead apron will be provided....Union official Gary Cwitco of the Communications Workers of Canada estimates 60 to 70 percent of the pregnant VDT operators at Bell Canada take advantage of a labor agreement allowing them to stop VDT work. (See *MWN,* May 1981.)... Results from Mt. Sinai's epidemiological study of VDT health effects are still months away. According to Dr. Arthur Frank, the study's director, the first batch of completed questionnaires from participating Newspaper Guild locals is now being processed. (See *MWN,* March 1981.)...News in the February 9 *Wall Street Journal* that NIOSH's Baltimore *Sun* study found no marked increase in the incidence of cataracts among VDT operators took institute investigators by surprise. NIOSH's Dr. Shiro Tanaka did not refute the *Journal's* report; he told *Microwave News* that no results have been released on the 400 some eye exams performed for the study. The report will take at least a few more months to complete. (See *MWN,* March 1981.)... Commenting on reports of problem pregnancy clusters among clerical workers, Dr. Nancy Binkin at the Center for Disease Control in Atlanta, GA, said "fifty clusters in one year would not be significant, given the large number of workers and VDTs." She warned against lumping together different types of birth defects and miscarriages. (See *MWN,* November 1981 & January/February 1982.)...A sympathetic judge in Frankfurt, Germany, dismissed charges against a bookkeeper who attacked his company's VDT with a chair and then set it on fire. According to the January 29 *Guild Reporter,* the employee was frustrated by system failures that regularly forced him to work overtime.

Massachusetts Standard *(continued from p. 1)*

April 29 in Boston. Since the legislature authorized the state agencies to set a standard for non-ionizing radiation in 1980, the standard becomes official 30 days after its publication in the *Commonwealth Register,* the state's official record. The new rule could be in effect by this summer.

The limits in the population standard are in fact the same as the new ANSI standard except that all values have been reduced by a factor of five. The other major difference is that the averaging time for measuring exposures will be 30 minutes instead of ANSI's six minutes. The variation, Watkins explained, was favored because the standard is designed to protect the public from long-term chronic exposures.

The occupational limits would only apply to medical and educational institutions. The Department of Public Health is, however, working with the state's Department of Labor and Industry, which is likely to issue a similar standard to protect other workers in the state. The averaging time for occupational exposures is six minutes.

In addition, there is a proposed emission standard for microwave ovens: a 5 mW/cm^2 leakage limit for ovens made after October 5, 1971, and 10 mW/cm^2 for those made before that date.

The proposed standard has an exclusion clause which allows the limits to be exceeded "if the exposure conditions are shown by laboratory procedures approved by the Director [of the Radiation Control Program of the Massachusetts Department of Public Health] to produce a spacial peak specific absorption rate below eight watts per kilogram averaged over any one gram of tissue" and an average, whole-body SAR below 0.08 W/Kg for the public and 0.4 W/Kg for workers. Devices with an input power of seven watts or less are also excluded.

The proposal was drafted by an ad hoc committee on nonionizing radiation chaired by Watkins. Its membership includes Dr. Sol Aronow of Massachusetts General Hospital, Representative Argeo Cellucci of the state legislature, Dr. Samuel Fine of Northeastern University, Dr. Padmakar Lele of MIT, Dr. John Osepchuk of Raytheon and Dr. John Shapiro of Harvard.

The department has published a report which contains an introduction to RF/MW radiation and a rationale for the standard, "105 CMR 122.000: Regulations Governing Machines Which Generate Radio Frequency Electromagnetic Fields." For a copy of the report and the rationale, contact: Robert Watkins, Department of Public Health, Room 770, 600 Washington Street, Boston, MA 02111.

RFI at TMI *(continued from p. 1)*

radio signals had interfered with the combustible gas meter and that the chromatograph analysis had been faulty. A workman's portable radio had confused the hydrogen gas meter, yielding unreliable readings.

A spokesman for General Public Utilities (GPU), the owner of the plant, refused to disclose either the type of meter which had been susceptible to RFI or the type of two-way radio used at the plant. GPU's Doug Bedell did say, however, that the walkie-talkie in question consisted of a microphone in the worker's face mask with a receiver in the belt of his protective suit.

None of the RFI experts contacted by *Microwave News* were surprised by the incident. They acknowledged that such events are possible, though unlikely. Some warned that the absence of federal standards for RFI made potential problems difficult to control. In a staff report released last July, the Federal Communications Commission concluded: "As our society becomes more and more dependent on electronics and electronic communications, societal problems stemming from RFI can only get worse unless significant parallel action is taken."

A spokesman for the Nuclear Regulatory Commission said it could not compel the release of any information on the interfering equipment. The commission is not investigating the "unusual event" at TMI, but it will review the GPU's report on the incident.

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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.*

New Light on ELF Radiation

Leukemia Again Linked to EM Fields

A statistical analysis of mortality data from England and Wales has "reinforced" recent US findings linking leukemia to occupational exposure to electromagnetic fields. This is the third report published since last summer that identifies an association between cancer mortality and working in electrical environments. In addition, a soon-to-be published study from Sweden implicates extremely low frequency (ELF) fields as a cause of congenital malformations among the children of men who work in high voltage substations. In the last few months there have also been two other papers indicating a connection between cancer and ELF alternating magnetic fields (AMFs) among the general population.

The latest cancer report, published in the January 29 *Lancet* by Michael McDowall of the Office of Population Censuses and Surveys in London, reveals a consistently higher mortality rate from lymphoid and myeloid leukemia among male electrical and electronic engineers and telegraph radio operators aged 15-74 in England and Wales during 1970-1972. The rates of acute myeloid leukemia (AML) were particularly high. The analysis of data on AML among workers in England and Wales in 1973 identifies "consistently increased relative risks for the electrical occupations, the highest risk being for telecommunications engineers."

An editorial in the same issue of *Lancet* cautions that "it is impossible to know what the observations mean," but that "the cluster of reports relating to [AML] is worrisome." It concludes: "Since all of us are exposed to some electrical and

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Very Weak Pulsed Magnetic Fields Affect Development

Recent experiments in Spain indicate that extremely weak pulsed magnetic fields at frequencies of 10, 100 and 1,000 Hz can have a "consistent and powerful" effect on the development of chicken embryos. The field exposures were so low that many researchers find the results hard to believe. Nevertheless all agree that the experiment should be repeated. If replicated, the Spanish work would have a major impact on the direction of radiation research.

A group headed by Dr. Jose M.R. Delgado at the Centro Ramon y Cajal Hospital in Madrid has found that extremely low frequency (ELF) pulsed magnetic fields at intensities ranging from 1.2-120 milligauss can upset chick embryonic development. They reported their findings in the *Journal of Anatomy*, a well respected, peer reviewed British journal. The article has been circulating among a small circle of researchers since it was published last May, but has escaped more general scientific and public attention. Richard Tell of the Environmental Protection Agency's (EPA) Office of Radiation Programs called Delgado's findings "amazing." He said that "if it checks out, this could be one of the most significant studies in years."

Delgado's Experiment

Delgado placed newly fertilized chicken eggs inside a coil connected to a

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ELF: Leukemia *(continued from p. 1)*

magnetic fields, and continuously to low levels of non-ionizing electromagnetic radiation, it is important to know what risks, if any, are entailed." The *Lancet* is a highly regarded British medical journal.

Congenital Malformations

A soon to be released paper from Sweden also questions the safety of occupational exposures to ELF fields. Dr. Stefan Nordstrom of the University of Umea and co-workers report that children born to men who work in high voltage substations have an increased incidence of congenital malformations. The authors of the retrospective study hypothesize that "as a result of working in electrical fields in the switchyards, the employees' bodies and/or objects in the switchyards are electrically charged and then discharged ...Cell disturbances, including chromosomal aberrations, may be caused by such charges/discharges." They advise that while these results are statistically significant, they are based on only a small number of cases. The paper is scheduled to be published in the next issue of *Bioelectromagnetics*.

Commenting on these studies, Dr. Robert Becker said, "Researchers must start doing epidemiologies." Interviews with many other scientists indicated a growing consensus that more detailed research must now be carried out. Becker, the author of *Electromagnetism and Life* (with Dr. Andrew Marino), believes that ELF fields can act as generalized stressors and as enhancers of cell division. Under certain conditions, these could cause malignancies and developmental aberrations, he argues.

A similar view is held by Dr. Clay Easterly of Oak Ridge National Laboratory in Tennessee, who has written a number of papers on the risks associated with magnetic fields. In 1981, he proposed a hypothesis to explain how magnetic fields could promote cancer (rather than initiate it): magnetic fields may alter cell replication and thus act as a stimulus for the proliferation of latent tumor cells, leading to the development of malignant tumors.

Other Recent Studies

Last July, Dr. Samuel Milham, Jr., reported an association between leukemia and exposure to electric and magnetic fields among workers (see *MWN*, July/August 1982). Milham's results were then confirmed by a research group at the University of Southern California (USC) with occupational cancer data for Los Angeles (see *MWN*, December 1982). The USC study identified an increased risk of developing AML, especially among power linemen.

With respect to the general population, in 1979, Dr. Nancy Wertheimer and Ed Leeper reported a correlation between exposure to electric power lines and childhood cancer. A similar study in Rhode Island failed to show such a relationship, however. Wertheimer and Leeper recently extended their results, finding that AMFs were also associated with cancer in adults (see *MWN*, January/February 1983). And last year, a Swedish group found support for Wertheimer's original study using cancer statistics from Stockholm (see *MWN*, November 1982).

In a speech delivered last May before the new series of cancer reports appeared, Dr. J.A. Bonnell concluded that there was no evidence to contradict the view that electric fields were harmless up to transmission voltages of 400 kV, and probably for voltages as high as 800 kV. Dr. Bonnell, a medical adviser to the Central Electricity Generating Board in London, published his speech in the December issue of the *Journal of the Royal Society of Medicine*.

Phone calls to the Electric Power Research Institute in Palo Alto, CA, which sponsors some research on the biological effects of ELF fields for a consortium of electrical utilities, were not returned.

NY Sponsors Research

The New York State Department of Health's Power Lines Project is in the midst of planning an epidemiolgical study of the relationship between 60 Hz electromagnetic fields and cancer in the general population. Pre-proposals are due March 22. For more information, see the notice in the February 18 *Science* (p.893) or call (518) 474-4170.

Last year the project announced an award to SRI International for an epidemiological study of electric utility workers but the effort was suspended after questions were raised about the way the cohorts were defined (see *MWN*, November 1982).

The New York project's Scientific Advisory Panel is also looking into the possibility of re-analyzing Wertheimer's data on childhood and adult cancer. The expert panel has hired Dr. Annemarie Crocetti, a New York-based consultant in epidemiology, to advise them on the status of the data.

The panel will meet March 27-28 in Albany to review pre-proposals for the epidemiological study, consider Crocetti's report and evaluate the state's entire $3.5 million research program.

ELF: Magnetic Fields *(continued from p. 1)*

generator of rectangular waves with a pulse duration of 0.5 milliseconds. Eggs were exposed to magnetic fields of 0.12 micro Tesla (uT), 1.2 uT and 12 uT. (1 uT = 0.01 gauss, so these fields are equivalent to 1.2, 12 and 120 milligauss) for 48 hours at frequencies of 10, 100 and 1,000 Hz. At the two higher frequencies and for each of the three intensities, Delgado reports significant malformations, especially in the nervous system and the heart. While exposures to 10 Hz magnetic fields were not free of abnormalities, he notes that a "trend toward normality was evident."

Delgado found the "most marked and uniform effects on embryological development" at 100 Hz and 1.2 uT. Under these conditions, microscopic analysis indicated "drastic" changes in tissue structure: "There was little cellular differentiation, and a lack of organization of cells, without mutual cohesion, resulted in a fragile tissue..." He deduces that the mechanism of action of the ELF magnetic fields is "slow and cumulative," and that "embryonic organs reacted with different sensitivity" to the different parameters of the field. He finds that any thermal effects were "minimal and may be disregarded." Delgado also maintains that he observed frequency and power windows because embryos exposed to fields of 100 Hz and 12 uT were less developed than those exposed to higher and lower frequencies and intensities.

Skepticism Until Replication

Most scientists interviewed about Delgado's paper found it difficult to believe that such weak magnetic fields could have so profound an effect. For instance, Dr. Lionel Jaffe of Purdue University said that he viewed the results with extreme skepticism

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