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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.

Microwaves Promote Cancer

Microwaves can promote cancer, according to the first long-term study of microwave exposure ever carried out in the United States. The \$4.5 million study revealed that exposures to low levels of pulsed 2450 MHz radiation caused a statistically significant increase in malignant tumors among rats.

The new cancer data come from a five-year study headed by Dr. Arthur W. Guy, the director of the Bioelectromagnetics Research Laboratory at the University of Washington School of Medicine in Seattle. The study was sponsored by the U.S. Air Force.

In addition to a general increase in cancer incidence, the experimental results suggest that microwave exposure is responsible for wide-ranging effects related to the adrenal glands and the entire endocrine system.

If confirmed, the new study would undermine the 1982 American National Standards Institute (ANSI) radiofrequency and microwave (RF/MW) radiation exposure standard. That standard asserts that the level of exposure used in the Guy study is safe.

The findings are far from definitive, but a number of experts found the preliminary and unpublished data highly suggestive of a link between microwave radiation and cancer, possibly through a stress reaction. In numerous interviews, researchers expressed rare unanimity in calling for a replication study because of the serious implications for public and occupational health.

"The bottom line is that the study must be repeated," said Dr. Barbara Chang, a hematologist and oncologist at the Medical College of Georgia in Augusta.

Chang explained that "there is increasing evidence that microwaves may be a tumor promoter," but cautioned that "there is no direct evidence that microwaves can induce cancer." Chang was a member of the ad hoc panel that recently evaluated the Environmental Protection Agency (EPA) literature review of RF/MW radiation bioeffects (see *MWN*, October 1983 and January/February 1984).

The new results lend support to an earlier Polish study which found that microwaves can promote cancer at higher exposure levels. Dr. Stanislaw Szmigielski showed that 2450 MHz radiation can enhance the carcinogenic action of benzopyrene (see accompanying story on past studies).

(Current theories hold that the development of cancer is a multi-step process. An important distinction is made between the induction and promotion of cancer. Induction refers to the initial transformation of the cells that leads to their uncontrolled growth, while promotion refers to the enhancement of that growth process or the survival of the transformed cells.)

Guy's Experiment

Guy and his collaborators exposed 100 male rats to 0.48 mW/cm² of 2450 MHz, 8 Hz amplitude modulated pulsed microwaves (10 microsecond pulses, 800 pulses per second) for 21 hours a day for up to 25

(continued on p.4)

Magnetic Fields Induce Temperature Changes

Magnetic fields like those associated with nuclear magnetic resonance (NMR) imagers can induce relatively large changes in the temperature of live mice, according to a recent paper by German scientists. This new, unexpected finding has surprised many leading researchers.

A team working under Professor Klaus Dransfeld of the Department of Physics at Konstanz University measured a detectable increase in rectal and surface temperature of mice placed in a static magnetic field of only 0.4 Tesla (T). The temperature effect begins to saturate in a field of 2 T, with little further heating as the magnetic field is increased to 8 T.

Interestingly, the temperature increase was only observed when the mice were in certain orientations in the magnetic field. In another orientation, there was a decrease in temperature as the strength of the magnetic field increased. (Reversing the direction of the magnetic field by reversing the coil current had no effect on the direction of the temperature change.)

The authors cannot explain what biological processes could cause the observed effect. They do note that there is a translational force (proportional to the susceptibility of biomolecules) in inhomogeneous magnetic fields which does change directions like the observed temperature.

In one experiment with a 3 T magnetic field, the rectal and dorsal temperatures of the mouse started to increase in about four minutes. The temperature continued to increase for three hours for a net change of 2.4 degrees Centigrade (C). After the magnetic field was turned off, it took two hours for the temperature of the mouse to return to normal.

Dr. Rudolf Oldenbourg, a co-author of the paper and presently a visiting post-doctoral researcher at Brandeis University's Martin Fisher School of Physics in Waltham, MA, said the group had run the experiment at different times and had always observed the same qualitative response. "Beyond any doubt there is a temperature change due to the magnetic field," he said in a telephone interview.

This study was motivated by a report of observed temperature increases as great as 5 degrees C in humans exposed to fields similar to those of NMR imagers. This observation has not been formally published, but is reported in a working paper cited in Dransfeld's paper. Oldenbourg believes that these temperature increases were measured for exposures to magnetic fields of up to 1.5 T.

In a series of interviews, experts in the field expressed surprise over Dransfeld's experiment. None could offer an explanation for his results and many were incredulous.

Dransfeld's findings could have an impact on the assessment of the risks of NMR imagers, which are using stronger and stronger magnetic fields. For instance, Technicare, a Johnson & Johnson subsidiary, has won government approval to market NMR units with magnetic fields of 0.6 T, and has four machines with 1.5 T fields undergoing trials at various clinics across the country. A spokesman for the company said that units with fields of up to 2.0 T are being tested in-house.

To date, there have been no reports of ill effects due to NMR imagers, from either their static magnetic fields or from their pulsed radiofrequency signals. Indeed, the Food and Drug Administration's Center for Devices and Radiological Health noted in its May *Radiological Health Bulletin* that, "The only significant adverse effect [of NMR imagers] observed was claustrophobia in about four percent of the subjects."

Dransfeld's paper appears in *Naturwissenschaften*, 71, 100, 1984, a prestigious German journal. The paper is written in English. Dransfeld was formerly with the Max Planck Institute for Solid State Physics in Stuttgart and the High Magnetic Field Lab in Grenoble, France.

Power Substations: EMI and Community Concerns

Computers and other electronic equipment in power substations can fail due to electromagnetic interference (EMI) from transients. This is the conclusion of a study headed by Dr. B. Don Russell of Texas A&M University in College Station and sponsored by the Electric Power Research Institute (EPRI). As engineers turn their attention to this problem, citizen groups are showing greater concern over the potential health effects of the EM fields associated with substations.

EMI From Transients

Russell and co-workers have characterized the transients which are caused by the operation of breakers and disconnect switches: the frequencies range from several hundred Hz to more than 200 MHz, with amplitudes of up to 70 kV/m and higher. Though the exception is the rule, a "typical" waveform lasts 10 microseconds, is in the 20 MHz range and has an amplitude of 5 kV/m (electric) and 3 A/m (magnetic). The "typical" transient generated by a 345 kV switch has a rise time of 180 nanoseconds (ns) (electric) and 60 ns (magnetic); for a 500 kV switch, the rise times are 700 ns (electric) and 100 ns (magnetic).

With respect to the EMI shielding that can be provided by a substation control building, Russell's group found an attenuation of about 15 dB in the 10-100 MHz range and up to 20-25 dB in the 1-10 MHz range, though they add that there are "significant holes" in this shielding.

Russell and co-workers warn that transients "represent a significant potential problem in terms of equipment interference... Failures will occur due to these transients; it is only a matter of time."

A brief summary of Russell's findings appears in two papers published in the July issue of the *IEEE Transaction on Power Apparatus and Systems*. The complete report, *Measurement and Characterization of Substation Electromagnetic Transients*, (No. EL-2982) is available from EPRI, Research Reports Center, Box 50490, Palo Alto, CA 94303, (415) 965-4081. Two related papers on a long-term transient monitoring system in a 138 kV and a 500 kV substation and transmission line, by a team headed by M.D. Perkins of Westinghouse Electric Corp. in Pittsburgh, PA, are in the August issue of the *IEEE Transaction on PAS*.

Public Concerns

Citizen concerns about the potential hazards of EM radiation associated with power systems are growing: disputes over substations have joined on-going controversies over transmission lines. The difficulties experienced by New York City's Con Edison and by Florida Power and Light (FP&L) may be an omen for other utilities.

Con Edison is building a substation near the United Nations and across the street from a housing development. A group calling itself HEED (Help End Environmental Danger) has succeeded in drawing attention to the plant, which is now half completed. In June, the City Council heard testimony on a motion to halt construction pending the writing of an environmental impact statement.

Dr. Abraham Liboff of Oakland University in Rochester, MI, testified for HEED arguing for a cautious approach in light of new research showing that magnetic fields are more biologically active than previously thought. A number of local politicians also spoke in favor of HEED's position.

Con Ed says there is no risk, citing measurements from a nearby substation that showed magnetic fields are on the order of a fraction of a milligauss, 80 feet from the station and 30 feet above the street. Con Ed's Dr. Peter Freudenthal told the council that there are 20 other substations in the city and "it would be ridiculous to stop this project." A decision from the City Council is expected soon.

In Coral Springs, FL, the community is trying to stop FP&L from building a substation that has already been shut out from a neighboring community. Citizens wanted to invoke a new state law, authorizing the state Department of Environmental Regulation (DER) to establish safety requirements for power lines (see *MWN*, July/August 1983). But, as DER's Karen Anthony told *Microwave News*, the law does not apply to substations.

Appeals Court Lifts Ban On Project ELF Construction...

A federal appeals court has lifted the construction ban on Project ELF in what may be the final blow to opponents of the Navy's massive land-to-submarine communications system. The June 13 order of the Seventh Circuit Court of Appeals in Chicago suspends a district court injunction against further construction pending completion of a supplemental environmental impact statement (EIS) on the project (see *MWN*, March 1984).

The appeals court is not expected to issue its decision on the project's future until this fall. Meanwhile, the Navy is proceeding with both the project and the mandated study.

The State of Wisconsin and Marquette County, Michigan, the plaintiffs in the original suit, believe that the study will be a pointless exercise if construction is allowed to continue. In an interview shortly after the appeals court ruling, Shari Eggleston, Assistant Attorney General for Wisconsin, explained that the Navy is under no obligation to act on the EIS findings should they show a health risk associated with ELF radiation and that it is extremely unlikely that the study, which is not expected for release until February 1985

at the earliest, will affect a project that is already largely completed.

In a last ditch effort to slow the project, the state and the county applied to the US Supreme Court on August 1 for a stay of the appeals court order — thus reinstating the construction ban — until the court of appeals issues its decision. The plaintiffs filed a similar motion with the appeals court on July 9. As we go to press, neither court has responded.

In the two paragraph order released on June 13, the three judges hearing the appeal stated that "we do not perceive any reason or justification for further delaying the implementation of this national defense project authorized by Congress and directed by the President."

The Navy has maintained throughout the court proceedings that national security will be jeopardized if the project is delayed.

Construction has now resumed at the Wisconsin Project ELF site at Clam Lake, and the Navy expects to award a contract for the transmitter in Michigan by August 31, with construction on the state's Upper Peninsula to begin in September. The Navy originally scheduled to complete the Clam Lake facility in September 1985 and finish all work by April 1986. According to a Navy spokeswoman, the Navy is "currently assessing the impact of the four-and-a-half month delay created by the court-ordered injunction."

...AIBS Gets Key Role in Project ELF EIS

The Navy has chosen the American Institute of Biological Sciences (AIBS) to coordinate the literature review and analysis for the Project ELF supplemental environmental impact statement (EIS). The review will cover the bioeffects literature for extremely low frequency (ELF) radiation published after the Navy's 1977 EIS.

Under a \$319,000 Navy contract, AIBS has set up a nine-member panel chaired by Professor H.B. Graves of Pennsylvania State University. Both Graves and an AIBS spokesman told *Microwave News* that panel membership and the topic areas to be covered will not be finalized until mid-August and so they declined to discuss details — including who will serve on the panel.

The panel's report will incorporate material from two key sources. In addition to data provided through the Navy-contracted literature search underway at the IIT Research Institute (IITRI), in Chicago, IL, the panel will solicit research reports from experts in specific topic areas.

Although the AIBS report will include the panel's summary analysis, the EIS and its final conclusions will be written by the Navy. The Navy has set an October 31 due date for the report, but Graves indicated that this date may be hard to meet. Should the Navy's schedule hold, a draft EIS will be filed in mid-November and a final version completed sometime in the February-April period. The Navy is also planning to hold public hearings, probably in December.

AIBS is a 9,000 member not-for-profit scientific and educational organization based in Arlington, VA.

months. The rats, which were housed in a pathogen-free environment, had a maximum average specific absorption rate (SAR) of 0.4 W/Kg. One hundred rats were used as controls.

Guy's results were presented at the annual meeting of the Bioelectromagnetics Society (BEMS) in Atlanta in mid-July by Drs. C.K. Chou and Lawrence Kunz. In two separate papers, they delivered low-key assessments of their findings: a doubling of the weight of the adrenal glands and an excess of total malignancies among the exposed rats. Both effects were statistically significant. The speakers did not link the two effects, however, treating them as independent findings.

Kunz, the group's veterinary pathologist, noted that the incidence of each type of cancer in the rats was not in itself significant. The increase in cancer only became statistically reliable when the data were collapsed into a total cancer incidence index. In addition, he said that the cancer rate was not significant compared to historical controls rather than those actually used.

A Private Meeting

The presentations left much of the audience confused about what the results mean. But a clearer picture emerged later during an informal meeting with Kunz in Guy's hotel suite. Among those attending the briefing were researchers from EPA, the National Institute for Occupational Safety and Health (NIOSH), Dr. Chang, Dr. Don Justesen of the VA Hospital in Kansas City and Dr. Sam Milham of the Washington State Department of Social and Health Services.

Kunz reviewed the cancer data in some detail: There were 16 malignant tumors among the exposed rats, but only four among the controls. He went on to describe each type of tumor.

Based on this list, Chang and Milham immediately deduced a pattern of increased malignancies in the endocrine system. There were seven endocrine neoplasms among the exposed rats compared to only one among the controls: two thyroid, two pituitary and three cortical adrenal tumors. (The adrenal, thyroid and pituitary glands are part of the endocrine system.)

Kunz also revealed that there were six pheochromocytomas or pheos—benign adrenal tumors—among the exposed rats but none in the controls. Pheos secrete epinephrine, a neurotransmitter, and are associated with high blood pressure and headaches. They have also been connected with stress.

Putting the Data Together

The emerging pattern of experimental results differed from the isolated observations presented at the conference. The exposed rats experienced a doubling of their adrenal mass, an increase in the number of adrenal and other endocrine tumors, and an increase in the number of benign adrenal tumors, as well as a general increase in overall tumors.

Two theories were put forward by those assembled in

Guy's suite. The observed effects could be caused directly by the microwave radiation, or they could be the manifestation of a general stress reaction brought on by the radiation.

Guy's results could provide an experimental basis for the widely reported complaints among workers chronically exposed to microwave radiation: headaches, dizziness, memory loss and fatigue. These symptoms have become known as "the microwave sickness."

Kunz resisted the notion that his results formed a coherent and consistent picture of adverse effects. He suspected that the increase in cancer was not a true finding. "I doubt that these data are reproducible," he said.

All those present wanted to see the experiment repeated, a desire that would take years to satisfy. "We might be seeing anything from an anomalous lowering of controls to a true difference indicative of non-specific stress," Justesen said.

Milham, an epidemiologist and physician, later summed up the general sentiment of those who had heard the Kunz-Guy briefing: "There appears to be a pattern in the data. It says at minimum that the experiment should be repeated."

One common observation was that Guy's group had not set out to test whether microwaves are carcinogenic—instead they studied a large number of health-related end points looking for any and all ill effects. A second study could be specifically designed to test for the microwave-cancer link.

A Provocative Finding

The results of Guy's experiment are still under review by Air Force officials. One Air Force researcher told *Microwave News* that he would prefer to withhold comment until the tumor analysis had been completed. The raw data, including computer tapes of all the individual data points as well as the pathology slides will be made available to all interested parties, he said.

The Air Force has sent the Guy results to Dr. E.H. Vernot of the Toxic Hazards Research Unit at the University of California at Irvine for an independent analysis. In a letter to the Air Force, Vernot wrote that the "finding of excess malignancies in the exposed animals is provocative."

Guy referred all questions about the biological aspects of his study to Kunz. Guy's chief assistant, Professor Chou said in an interview that, "We are all concerned about this, but we should realize that we had a small sample size." He concluded that "I cannot say that microwaves cause cancer at this time."

For the moment, everyone is anxiously awaiting the publication of Guy's results so that the many explanatory hypotheses already circulating through the research community can be tested.

A description of Guy's experiment and his findings will appear in nine volumes published by the Air Force; a number of these are already available. The findings discussed here are not ready for distribution but should be printed soon as "Volume 8." For more information regarding the availability of copies, contact the Air Force's contract monitor, Jerome Krupp at the USAF School of Aerospace Medicine, Brooks AFB, TX 78235.

Implications for ANSI Standard

The rats in Guy's experiment were exposed to an SAR of 0.4 W/Kg, precisely the SAR level specified by ANSI as safe. "Whole body SARs below 4 W/Kg were not by consensus associated with effects that demonstrably constitute a hazard," the ANSI committee wrote in 1982. A safety mar-

gin of ten was then factored in. The frequency dependent exposure guidelines, 1 mW/cm² in the 30-300 MHz band, stem from the 0.4 W/Kg level.

More than one of the representatives from the federal agencies who attended the Kunz-Guy meeting noted that the new cancer results, if confirmed, would undermine the adequacy of the ANSI standard.

Past Cancer Studies

While Guy's experiment is certainly the most ambitious study, it is not the first to find a connection between cancer and microwaves. The issue has been and continues to be quite controversial, at least in part because there are so few studies in the bioeffects literature.

As Dr. William Kirk wrote in EPA's soon-to-be-released *Biological Effects of Radiofrequency Radiation*, "Because few RF radiation studies in man or animals have employed life span or cancer as end points and none has had sufficient statistical power and adequate quality control...the questions of RF radiation carcinogenesis or life shortening are still open. None of the complete reports in the literature presents a convincing case for the existence of a significantly increased risk of cancer induction...The data of Szmigielski *et al.*, however, raise the possibility that RF radiation may act as a cancer promoter..."

Szmigielski and co-workers at the Center for Radiobiology and Radioprotection in Warsaw have shown that microwaves can promote cancer: 2450 MHz radiation is a co-carcinogen with benzopyrene (*Bioelectromagnetics*, 3, 179, 1982). They discovered that microwaves accelerated the development of spontaneous and chemically induced tumors in mice. The Polish group concluded that, "It remains an open question as to whether the tumor-accelerating effect observed in mice exposed to MW fields at 5 mW/cm² is due to specific interaction of the radiation at the cellular or subcellular level...or to a nonspecific stress and/or adaptation reaction."

The other major paper in the microwave-cancer literature was published in 1962 by Susan Prausnitz and Dr. Charles Susskind of the University of California, Berkeley. They irradiated mice with pulsed 9.27 GHz microwaves (2 microsecond pulses, 500 pulses per second) for four and half minutes a day for 59 weeks at a level of 100 mW/cm² and found an indication of leukemia — an increase in neoplasms of the white blood cells (*IRE Transactions on Bio-Medical Electronics*, 9, 104, April 1962). In a 1976 review, the Food and Drug Administration called this experiment "the most discomfiting finding in the available literature." Nevertheless, no attempt has ever been made to replicate the Prausnitz-Susskind study.

Epidemiological Studies

A number of epidemiological studies have suggested a link between microwaves and cancer, though none are considered reliable.

• Dr. William Morton of the University of Oregon in Portland has correlated the incidence of leukemia with ex-

remely low (nanowatt) levels of broadcast radiation (see *MWN*, December 1983). EPA, which funded the study, faulted Morton's analysis and refused to publish his report.

• Drs. John Lester and Dennis Moore of the University of Kansas School of Medicine in Wichita uncovered a pattern of cancer incidence which appeared to be related to exposure to radar radiation, though they warned that the relationship was not strong enough to establish a correlation between the two (see *Journal of Bioelectricity*, 1, 59, 1982 and *MWN*, July/August 1982).

• The 1978 epidemiological study of Americans stationed at the U.S. embassy in Moscow uncovered a relatively high proportion of cancer deaths among female employees. Dr. Abraham Lilienfeld of Johns Hopkins University in Baltimore, MD, the study director, noted that there was also an anomalously high incidence of cancer among women stationed in other U.S. embassies in Eastern Europe who served as controls. Lilienfeld could not explain this finding, but hesitated placing too much importance on it because of the small sample size and the long latency periods associated with cancer induction. The microwave exposures at the embassy in Moscow were very low, in the microwatt range.

In addition, over the last few years there have been eight papers linking leukemia to extremely low frequency (ELF) electromagnetic fields (see *MWN*, March and June 1983). The current consensus among researchers is that the biological action by ELF radiation involves a different mechanism than higher frequency radiation such as microwaves — though the distinction may be blurred when microwaves are modulated at ELF frequencies.

Cancer Clusters in the Workplace

There have been at least two clusters of cancer among workers exposed to microwaves on the job. In each case, the ensuing investigations were inconclusive.

• In 1980, workers at the Communications Workers of America Local No. 4354 in Ragersville, OH, reported that five out of eight members of its AT&T Long Lines Depart-

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ment had developed cancer since 1971. NIOSH was called in to study the cluster, but investigators decided that it was an accidental grouping, unrelated to microwaves (see *MWN*, February 1981).

• Also in 1980, the United Paperworkers International Union disclosed a cluster of nine cancer cases among twenty women working on RF sealers at the Beaverite Products Plant in Beaver Falls, NY. NIOSH was again called in but could only identify six cancer cases. The agency did find that the women were exposed to radiation levels far in excess of the then current 10 mW/cm² standard. NIOSH decided to terminate the study, because as epidemiologist Terry Leet explained to the union, "There is no convincing evidence in the scientific literature to indicate that RF radiation causes cancer in humans or animals" (see *MWN*, November 1981). NIOSH has been trying to set up an epidemiological study of RF sealer operators for nearly ten years without success.

In the mid-1970's, two radar repairmen at the Naval Air Station at Quonset Point, RI, developed pancreatic cancer and endocrine disorders (the pancreas is part of the endocrine system). One of them, Robert Engell, charged that his condition stemmed from working with Tactical Air Navigation (TACAN) systems and filed a \$4.5 million suit

against ITT, Raytheon, General Dynamics, Varian Associates and Rockwell International. The suit was settled out of court under the stipulation that the amount of the settlement remain confidential (see *MWN*, November 1982 and January/February 1983). The issue of causality was never addressed in court.

1978 NIOSH Study

In 1978, NIOSH released a literature review of the carcinogenic properties of RF/MW radiation (*Carcinogenic Properties of Ionizing and Non-Ionizing Radiation: Volume II - Microwave and Radiofrequency Radiation*, March 1978). That study found that there was almost no information in the scientific and medical literature.

NIOSH argued in favor of a hypothesis proposed by Dr. Milton Zaret that an increase in cardiovascular disease and an "alleged" rise in cancer incidence in North Karelia, Finland, could be attributed to nearby high-power, Soviet radars (*Medical Research Engineering*, 12 13, 1976). In his analysis, EPA's Kirk discounts this theory as a "misunderstanding/misinterpretation," noting that a Finnish government spokesman has denied any knowledge of increased cancer in North Karelia or of any other microwave-related effect. ●

UPDATES

COMPATIBILITY & INTERFERENCE

ARRL v. Cable TV...The FCC has denied the American Radio Relay League's (ARRL) petition to bar cable television operators from frequencies used by the Amateur Radio Service. Calling the league's proposed solution to interference problems "excessive," the commission ruled that disputes can be solved through cooperation, as demonstrated by the joint special committee (of ARRL, the National Cable Television Association and FCC staff representatives) set up since the petition was filed in 1982 (see *MWN*, October 1983 and March 1984). As outlined in the commission's June 15 decision (No. 84-283 on RM-4040), the league claimed that severe interference, particularly on cable TV Channel E at 144-150 MHz, was "a direct result of cable TV systems using inadequate shielding, low quality components, poor cable installation techniques and inadequate maintenance." While noting "it is clearly the responsibility of the CATV system operator to solve such interference problems," the commission concluded there is "no justification in the record to preclude frequencies" from cable TV use.

RFI-Free Satcom Sites...Spectrum Planning Inc. has come up with a simple way for finding interference-free sites for C-band satellite earth stations. The company's new Pocket Map system can identify locations which are free of RFI from and to 4 and 6 GHz terrestrial microwave systems. Spurious 4 GHz radiation can degrade the operation of satcom receivers, while 6 GHz signals from uplink facilities

can in turn interfere with microwave receivers. The Pocket Map system factors in the transmit power, antenna discrimination, antenna centerline and transmission line loss of the terrestrial station with the gain and sidelobe of a standard earth station antenna to find acceptable sites. The technique, which also takes into account predicted propagation losses due to variations in terrain, produces maps which can be placed over USGS regional maps. For more information, contact Spectrum Planning's Randall Oster, 1850 N. Greenville Ave., Richardson, TX 75081, (214) 699-3536.

LITIGATION

Burgis Case Settled...Former Army radar technician Stanley Burgis settled his suit against Western Electric (now AT&T Technologies Inc.) for an undisclosed sum on July 18 (see *MWN*, December 1982). Burgis claimed that radiation from M-33 radar caused cataracts and retina damage. According to Burgis's attorney Gerald McHugh Jr., at the Philadelphia firm of Litvin, Blumberg, Matusow & Young, a condition of settlement is that the terms remain completely confidential. Although McHugh refused to comment on the settlement, a source familiar with the proceedings told *Microwave News* that it was "very substantial." McHugh estimated that his client was periodically exposed to over 40 mW/cm² and routinely exposed to 5 to 10 mW/cm² during the nine months he worked on the M-33 radar in the early 1950's. These estimates were based on Army and Air Force hazard surveys of other Western Electric M-33 radars. The

case, filed in 1980 before the US District Court for Eastern Pennsylvania in Philadelphia, was scheduled to come to trial on July 31.

EBI Patent Suit...Electro-Biology Inc. (EBI) is seeking over \$16 million from the manufacturer and marketers of a bone regenerating system it claims uses the same pulsed electromagnetic fields (PEMFs) as the EBI Bi-Osteogen unit. In a complaint filed in the US District Court for the Northern District of Texas on April 25, the Fairfield, NJ, company charged American Medical Electronics Inc. (AME) and its independent sales representatives with patent infringement and false representation of their product. AME, based in Dallas, TX, has answered the charges, and the case is now in discovery. EBI Vice President Richard Reisner told *Microwave News* that "signal specificity is key" to the effectiveness of the Bi-Osteogen system's non-invasive treatment of hard-to-heal fractures. He noted that, although it is possible that other signals might prove effective, EBI believes that the signal used in AME's Physio-Stim (for humans) and Thorough-Stim (for horses) units is the same as the Bi-Osteogen's. (There is no scientific consensus on how important signal characteristics are in achieving an effect.) Late last year, EBI concluded a successful defense against patent infringement claims from a subsidiary of Canada's Inco Ltd. (see *MWN*, December 1983).

MEASUREMENT

Magnetic Fields from Household Appliances...The IIT Research Institute (IITRI) of Chicago, IL, has completed the most detailed survey to date of magnetic fields from household appliances. Worst case measurements on 100 different appliances of 25 basic types by IITRI's J.R. Gauger found that 95 percent of the maximum magnetic fields at a distance of 1 foot (ft) were below 100 milligauss (mG) and below 1 mG at 5 ft. The maximum value at 5 ft was 4.7 mG. Small appliances with light motors in lightweight casings produced stronger fields than large appliances where the motor is often well shielded. For example, the maximum reading 1 ft from a can opener was 270 mG, dropping to 1.9 mG at 5 ft, while the maximum readings for a dishwasher were 26 mG and 0.7 mG at 1 and 5 ft respectively. The measurements were taken at 60 Hz. One electric shaver, however, generated its primary field at 120 Hz, and a television without a power transformer produced a 58 Hz field, the vertical sweep frequency. Background levels in the homes where the measurements were taken ranged from 0.5 to 1 mG. (The Earth's natural magnetic field, which is essentially static, is approximately 0.5 G, or 500 mG.) *Household Appliance Magnetic Field Survey*, Technical Report E06549-3, March 1984, was prepared for the US Naval Electronic Systems Command, Washington, DC 20360.

Resources...NBS has published *Electrical Parameters in 60 Hz Biological Exposure Systems and Their Measurement: A Primer*, Technical Note 1191, by M. Misakian. It is available from the Government Printing Office, Washington, DC 20402 for \$2.25 (prepaid). Order No. 003-003-

02581-1...Georgia Tech's Dr. Glenn Smith has published an article on "Limitations on the Size of Miniature Electric Field Probes," in the June *IEEE Transactions on Microwave Theory and Techniques*.... And a Canadian group headed by Health and Welfare's Maria Stuchly has written a paper on the performance characteristics of implantable E-field probes, which appears in the July *IEEE Transactions on Biomedical Engineering*.

MEETINGS

Hazard Assessment Symposium...EPA is sponsoring a *Symposium on Electromagnetic Field Measurements for Hazard Assessment* on October 10-12 at the Hacienda Resort Hotel and Casino in Las Vegas, NV. In addition, there will be a one-day tutorial, *An Introduction to Non-Ionizing Radiation*, on October 9. Among the topics on the agenda are the limitations of available instrumentation, new broadband and narrowband meters and calibration techniques. For more information, contact: Sheri Marshall, Dynamac Corp., PO Box 2198, Kensington, MD 20895, (301) 468-2500.

DOE-EPRI-NYS Bioeffects Review...This year researchers working under grants from the New York State Power Line Project will join those with funding from DOE and EPRI, who are studying the biological effects of high voltage 60 Hz and DC transmission lines at the 1984 Contractors Review. The meeting will be held at the Sheraton Hotel in St. Louis, MO, November 5-7. A block of rooms has been set aside for participants, and a special rate is available if you mention "DOE" to the reservations operator. Summaries of all the projects will be available two weeks before the meeting. If you are planning to attend or want a copy of the summaries, contact Dr. William Wisecup before September 1, Aerospace Corp., Suite 4000, 955 L'Enfant Plaza, SW, Washington, DC 20024, (202) 488-6328.

MILITARY SYSTEMS

EMP System on Chesapeake Bay...The Navy's plan to build a powerful Electromagnetic Pulse Radiation Environmental Simulator for Ships (EMPRESS II) on Maryland's Chesapeake Bay has met strong opposition from Governor Harry Hughes. In a July 13 response to an angry June 18 letter from Hughes, Secretary of the Navy John Lehman, Jr., promised to complete an environmental impact statement (EIS) before making a final decision on where to site the EMP generator. The Navy hopes to release a draft EIS in August. In order to test how well ship electronics would survive during a war, the EMPRESS II barge-mounted antenna would emit radiation similar to that released by a nuclear explosion. The EMP fields could reach 50 kV/m on ships approximately 100 meters from the proposed antenna. The inverted cone antenna will be 130 ft high by about 200 ft across the top. EG&G Washington Analytical Services Center recently won a \$20.3 million contract to design and develop EMPRESS II, which is scheduled to begin operation in 1987. Meanwhile, the Navy is discontinuing use of EMPRESS I, a less powerful, land-based system located at Point Patience, Solomons, MD.

POWER LINES

State Actions...Florida...A \$200,000 study of power line health and safety is getting underway in Florida to help the state's Department of Environmental Regulation evaluate the need for new rules. A five-member panel chaired by Professor H.B. Graves of Pennsylvania State University is scheduled to submit a report by January 1. The study is being funded by a consortium of Florida utilities: the state legislature mandated the investigation last year without providing necessary funding (see *MWN*, July/August 1983).

...Nevada...A June 1 federal court decision clearing the way for a ±500 kV power line through Henderson, NV, has been appealed. It all started when the town brought suit last year to move the line. Henderson argued that the environmental impact statement (EIS) for the 500-mile Intermountain Power Project line inadequately addressed health and safety issues and that the U.S. Department of Interior had overstepped its authority in granting route approval. Judge Leland Nielsen of the US District Court of Nevada found that the EIS was adequate, and more importantly, that local law could not take precedent over federal authority to grant right-of-way on federal land (*Citizens for a Better Henderson v. James Watt*, CV-LV 83-306, HEC). The appeal was filed June 22 in the US Ninth Circuit Court of Appeals in Las Vegas by the plaintiffs' attorney, Elizabeth Foley.

...Virginia...A joint subcommittee of the Virginia legislature set up to study power line health and safety issues (see *MWN*, June 1984) will hold its first hearing on August 9 in the town of Floyd. A second hearing for expert testimony

will be held in Richmond in September or October. For information, contact Ms. Terry Mapp, Division of Legislative Services, Virginia Legislature, PO Box 3A-G, Richmond, VA 23208, (804) 786-3591.

VDTs

Regulations for VDT Radiation?...Federal regulation of VDT radiation emissions falls within the authority of the Radiation Control for Health and Safety Act of 1968, according to a legal note published in the November 1983 *Southern California Law Review* (Vol.57, No.1). Author Sheryl Gordon McCloud argues that the Act "enables [the Center for Devices and Radiological Health] to regulate a risk of injury," (emphasis McCloud's) and that such a risk exists with VDT radiation emissions. The note, *Pink Collar Blues: Potential Hazards of Video Display Terminal Radiation*, challenges federal policies which assume that available data on VDTs are conclusive. McCloud argues that, "In the face of [the uncertainty about possible hazards], government publications assure us that VDTs are safe and that current standards are adequate. This note seeks to discredit these conclusions and to undermine the complacency they engender." She advocates "that federal rulemakers and policy makers acknowledge that our knowledge of VDT hazards is incomplete, and that our current rules, policies and standards offer no guarantee of safety to workers." Single copies of the law review are available for \$9.00 each from the Gould School of Law, The Law Center, University of Southern California, University Park, Los Angeles, CA 90089.

(continued on p.12)

CLASSIFIEDS

Microwave News reaches a select audience of specialists in non-ionizing radiation, and you can too. Advertise in *Microwave News* classifieds. Rates start at \$50 for 1/32 of a page, \$95 for 1/16 and \$175 for 1/8. For information or to reserve space, call us at (212) 725-5252.

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VDTs 1983 Now Available

Video Display Terminals: 1983 Health and Safety Update is now available for only \$7.50 prepaid. *VDTs: Health and Safety 1981-1982* is still only \$6.95 prepaid. Order your copies from *VDT News* now.

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EPA Options Paper on RF/MW Guidance

As we reported in our June issue, the Environmental Protection Agency's (EPA) proposed guidance for public exposure to radiofrequency and microwave (RF/MW) radiation has met stiff opposition within the agency and may be scrapped. It is now known that the objections are coming from EPA's Office of Policy Planning and Evaluation (OPPE). On May 11, shortly after the draft guidance was submitted for internal agency review prior to publication in the Federal Register, Deputy Assistant Administrator Jack Campbell of OPPE circulated an options paper recommending that EPA take no regulatory action on RF/MW radiation. The Office of Radiation Programs (ORP), apparently surprised by OPPE's stance, is now lobbying to save the guidance it spent five years developing. Agency officials have remained unusually tight-lipped about the ongoing struggle, and will only say that a decision is expected by fall.

The full text of Campbell's options paper is printed below. The paper was addressed to Assistant Administrators Joseph Cannon, Office of Air and Radiation, and Bernard Goldstein, Office of Research and Development (ORD).

Options for Addressing Potentially Adverse Health Effects from Public Exposure to Radiofrequency Radiation

ORP'S PROPOSAL

ORP is recommending that EPA use its Federal Radiation Council Authority to propose guidance which would limit public exposure to radiofrequency (RF) radiation. More specifically, ORP's proposal would provide federal guidance that RF exposure to the public should be limited to a whole-body *Specific Absorption Rate* (SAR) equal to or less than 0.04 Watts per kilogram (W/Kg).

ISSUES FOR RESOLUTION

The primary issues requiring resolution are as follows:

1. Should EPA propose guidance?
2. If guidance is to be proposed, what SAR value is appropriate?

BACKGROUND

There are no federal standards/guidelines for controlling exposure of the *general public* to RF radiation in the environment at this time. (But there are FDA standards for microwave ovens, OSHA recommendations for limits on occupational exposures and a voluntary "standard" for occupational exposure developed by the American National Standards Institute (ANSI).)

There is no statutory requirement to promulgate RF limits, but the agency has been requested to prepare guidance by various federal (FCC, NTIA), state and local agencies and private sector groups. Public comments to a December 1982 ANPRM [advanced notice of proposed rule making] strongly supported the development of RF guidance.

ORP believes guidance is needed to: (1) Limit the potential public health consequences of increasing and continuous exposure to RF radiation in the general environment, and (2) Provide a sound basis for (hopefully) uniform state and local standards. Final promulgation of Federal Radiation Guidance requires the President's signature. Guidance would not be "enforced" by EPA; each federal agency would be separately responsible for implementing and complying with the guidance, e.g., the FCC is granting or renewing radio licenses.

Important RF sources include such facilities as AM and FM radio stations, television, radar, satellite communication and microwave relay systems, land mobile radio and amateur radio.

Biological Effects

Biological effects are related to the rate at which RF energy is absorbed by an individual. This "dose rate" is usually expressed as watts per kilogram of body mass (W/Kg) and is termed the *Specific Absorption Rate* (SAR). The available information on biological effects of RF radiation have been critically reviewed and summarized in [an] extensive report prepared by ORD; the report has been reviewed and approved by the [Science Advisory Board] (SAB) for the purpose of standard-setting, although the SAB offered no guidance in where the standard should be set.

A very wide range of biological effects has been observed in experimental animals:

□ At levels far in excess of that found in the general environment, short-term whole-body exposure to RF radiation can be lethal (typically for SAR > 30 W/Kg). Brief exposure to similarly high RF levels in experimental animals has been shown to lead to birth defects, increased resorptions, lower birth weight and reduced survival rates in general.

□ At somewhat lower SAR levels of 4-30 W/Kg (but still far above levels found in the general environment), generally observed effects in experimental animals include decreased birth weight, reduced fertility, and various immunologic, hematologic and hormonal effects. Changes in animal behavior have also been observed. (In some experiments, a SAR in the range 4-6 W/Kg has been found to be lethal to rats, dogs and rabbits.)

□ At SAR levels beginning to approach those that may be formed in this general environment (somewhat less than 4 W/Kg), the public health significance of the observed biological effects are still controversial. Preliminary findings include various neurological, metabolic and histologic changes in animal tissue and cells *in vitro*; behavioral changes in animals exposed under conditions of high ambient temperature and humidity; and some tentative indication that RF radiation may act in some cases as a cancer promoter or co-carcinogen in animals at a whole-body SAR of 2-3 W/Kg.

In regard to the Specific Absorption Rate, the ORD report's Summary and Conclusions Section finds that "the data currently available on the relation of SAR to biological effect show evidence for biological effects at an SAR level of about 1 W/Kg. This value is lower by a factor of 4 than 4 W/Kg, the value above which reliable evidence of hazardous effects was found by ANSI (1982) following a review of the literature in February 1979." With respect to body ("core") temperatures, the review's Summary finds that "exposure of human beings at frequencies in the resonant region at an SAR of approximately 1 W/Kg produces significant changes in body temperature under some environmental conditions."

The report thus concludes that the "review of the currently available literature on RF radiation provides evidence that biological effects occur at an SAR of about 1 W/Kg; some of them may be significant under certain environmental conditions."

Public Exposure Data

Over the last decade, ORP has made fairly extensive measurements of RF radiation in the general environment. These measurements were generally made in terms of power densities (rather than SARs) expressed in terms of microwatts per square centimeter ($\mu\text{W}/\text{cm}^2$). Even in urban areas, where RF radiation levels are generally much higher than in rural regions, very few (if any) individuals in the general public are currently exposed to a SAR of 1 W/Kg.

ORP studies found that in 15 major U.S. cities 99.4 percent of the population were exposed to power densities $< 1 \text{ uW/cm}^2$ in the primary frequency range of interest (equivalent to a SAR of $< 0.0004 \text{ W/Kg}$ at resonance). About 0.3 percent of the population was found to be exposed to power densities from 1-to-2 uW/cm^2 ; 0.07 percent from 5-to-10 uW/cm^2 and 0.02 percent from 10-20 uW/cm^2 . (For reference, a 20 uW/cm^2 exposure is equivalent to a SAR of about 0.008 W/Kg at resonance.) The median exposure was estimated to be 0.0048 uW/cm^2 . Power densities in non-urban areas would typically be several factors of 10 lower. Thus, only a very small fraction of the population is exposed to RF levels that even approach those that are currently thought to be significant. The maximum level measured in urban ground-level locations commonly frequented by people was 10.9 uW/cm^2 (equivalent to SAR of about 0.004 W/Kg (at resonance)).

Sources likely to produce the most significant population exposure levels are FM radio and VHF television stations. *Field intensities generally decrease rapidly as one moves away from the broadcast tower.* Power densities from FM radio stations, for example, typically drop by a factor of 10 as one moves away from the base of the tower by a distance on the order of 150 feet. EPA measurements inside high buildings that are close to broadcast antennas have found power densities up to about 100 uW/cm^2 (or about 0.04 W/Kg at resonance). In special circumstances, EPA measurements at locations containing multiple-towers and/or multiple-antennas in very close proximity found power densities on public property of up to about 7,000 uW/cm^2 (or about 2.8 W/Kg at resonance). While often accessible to the general public, comparatively few people approach such locations and those people are typically there for only a brief period.

ORP's Rationale for the Proposed 0.04 W/Kg Standard

ORP is proposing to take this 1 W/Kg SAR value and reduce it to 0.04 W/Kg to derive RF guidance for the general public. (In the draft proposal, ORP actually starts with a SAR value of 4 W/Kg , a level at which biological effects are "obviously adverse," and reduces it to 0.04 W/Kg by using a safety factor of 100.)

The basis for ORP's proposal is as follows:

- The 4 W/Kg SAR "observed effects" level is based largely on animal data for short-duration exposures under non-stressful temperature and humidity conditions. (At higher temperature and humidity conditions, effects should occur at lower SARs.)
- There is currently little information on long-term effects in animals or humans.
- There are considerable differences in human susceptibility to thermal stress. Young children and older individuals are especially sensitive.
- Some biological effects are known to occur below 4 W/Kg .
- The SAR within specific parts of the body can exceed the whole-body average SAR value by as much as a factor of 100.
- For occupational exposures, the "safety factor" selected by the American National Standards Institute for its voluntary standard was 10. (For ionizing radiation, an additional factor of 10 is used to go from an occupational to a general population standard. A similar choice for RF radiation would result in an overall safety factor of 100.)
- Ambient temperature and humidity conditions in the general environment may be such as to impose thermal stress even ignoring the additional thermal stress potentially associated with RF radiation.
- Mathematical simulations suggest a 2.3 W/Kg SAR

should lead to a 1 degree C increase in human ("core") temperature. (Occupational standards recommend that workers should not be permitted to continue their work when their temperature rises by 1 degree C.) A 1 W/Kg SAR is estimated to increase core temperature by about 0.5 degree C.

□ Economic impacts do not appear to be especially sensitive to the safety factor of 100. (More on this shortly.)

OPPE Position

OPPE recommends Option 1 [see below] which provides for the dissemination of all available health information to the public, FCC and others interested in this issue. OPPE does not believe available data indicate a need for EPA regulation, because:

□ There are only a few facilities (if any) exposing individuals to RF radiation at levels where adverse effects have been observed in animal studies.

□ Studies did not show effects thought to be adverse until the SAR was $> 1 \text{ W/Kg}$, while it is true that most animal studies were short in duration and didn't account for higher temperature or humidity. This is several orders of magnitude above typical exposure levels.

□ We have no basis to assume that long-term biological changes will be adverse to human health. This kind of uncertainty is common among EPA's health related actions.

□ It is probably true (although we don't have epidemiological data that children and the elderly are more sensitive to RF radiation but the number of exposed people must be remembered: 99.4 percent of the urban population and (presumably) essentially 100 percent of the rural population are exposed to less than 0.0004 W/Kg . (The remainder of the urban population is thought to be generally exposed to less than 0.008 W/Kg .)

□ It is true that biological effects are known to take place below 4 W/Kg but it is not established that these are adverse to human health.

□ The safety factor of 10 chosen by ANSI is arbitrary; the safety factor of 100 proposed by ORP is equally so; both are well below the observed health effects level.

□ While it is possible that ambient weather conditions could exacerbate RF health effects, this possibility has not been studied in detail sufficient enough to be used for guidance (at the RF radiation levels normally found in the general environment).

□ It is true that the cost to society of this standard is not enormous. However given the remote probability that someone would die of ambient RF exposures, the cost per life saved of this standard is infinite.

□ The 0.04 W/Kg standard is inconsistent with the risk management decisions EPA has made in: (a) benzene (NESHAP) (b) arsenic (NESHAP) (c) asbestos (Section 5 TSCA) (d) EDB (e) SO₂ (NAAQS) (f) PM (NAAQS).

□ It has been suggested that an EPA standard will give the public assurance that they are safe from RF. If this is true, exposures above the standard would probably be perceived as dangerous (even though perhaps below the observed effects level). We have no assurance that states won't automatically regulate below any EPA standard.

Compliance Measures

At broadcast stations where guidance is exceeded, ORP suggests there are generally several alternative ways to achieve compliance. Depending on circumstances, these may include:

- Post area over guideline;

- Replace existing antenna with a more efficient design with standard 1-wavelength spacing;
- Replace existing antenna with 1/2-wavelength spacing;
- Lease on taller existing tower;
- Build new tower on an existing site;
- Build a tower on a new site; and
- Prohibit public access.

Economic Impacts

For commercial *broadcast* stations, preliminary estimates indicate that the exposure limit of 0.04 W/Kg ORP is recommending would have an estimated net total present value cost of about \$22 to \$52 million (1983\$). Actual expenditures would be expected to be spread over a six year period. Mid-range cost estimates and the estimated number of affected facilities for various SAR levels are as follows:

SAR	Economic Impacts ¹	Number of Stations Potentially Affected ¹
4.0 W/Kg	\$11 million	178
1.0 W/Kg	\$12 million	456
0.4 W/Kg	\$15 million	1122
0.08 W/Kg	\$28 million	1745
0.04 W/Kg	\$39 million	3361

¹ORP staff state that these are "worst-case upper-limit" estimates and indicate that further analysis will substantially reduce both the cost estimates and the potential number of stations affected.

These estimates are currently being revised, but ORP staff believe the costs are not expected to change markedly. ORP is currently surveying FM radio stations to determine actual land use in the immediate vicinity of the transmitting towers. Results are not expected for some months, but ORP staff expect this information may lead them to reduce cost estimates significantly.

Non-broadcast sources (e.g., radars and satellite communication systems) were also studied. Theoretically calculated field intensities were estimated. The number of government installations affected by the guidance was found to be a few percent of the total number of installations. No cost analyses were performed for these sources, however, because of the lack of cost data for much of the military equipment and the great diversity of site parameters.

OPTIONS

Given the above information, several options seem worthy of consideration from OPPE's standpoint. ORP recommends Option 5.

1. Distribute Information to the Public.

Take no regulatory action but distribute health data to the public, noting that people are safe given expected exposure rates. Continue research if necessary.

a. Pro: (1) Avoids unwarranted fears that could result from setting a stringent standard. (2) Gives states, cities and the FCC assurance that people are not at risk. (3) Avoids inconsistency with ANSI (occupational) standard. (4) Avoids the need to make a sweeping risk management decision which might result in economic impacts that go beyond what can be currently estimated. (5) Avoids unnecessary expenditures of society's resources. (6) Exposures to RF radiation which may result in adverse health effects could still be addressed by FCC and others using EPA health data.

b. Con: (1) Could be perceived as unresponsive to state, FCC and industry requests for a standard. (2) Would offer no protection.

2. Take No Action at This Time.

Since EPA is not required by statute to propose RF guidance, taking no action at this time would permit ongoing biological, technical and economic analysis to be further refined.

a. Pro: (1) Since the general population is presently under little, if any, risk from RF radiation, an extended delay to permit further advances in the bioeffects research makes it possible to substantially improve the guidance when issued within the next few years. (2) In principle, RF guidance developed after a delay significant enough to permit a substantial increase in our knowledge base should be better able to protect the public with less chance for economically burdensome impacts due to an overly protective standard. (3) Consistent with current understanding of effects at known exposure levels over short periods of time.

b. Con: (1) Not responsive to federal, state and local requests for RF guidance. (2) More (non-uniform) state and local standards could be established and these could impose a greater cost to society than Options 3-5. (3) Some additional installations of new RF sources could be stopped or delayed by undue public concern over RF radiation.

3. Base Proposed Guidance on a SAR of 1.0 W/Kg.

ORP's draft would be revised to conform to a maximum SAR of 1.0 W/Kg.

a. Pro: (1) A SAR of 1.0 W/Kg is the level at which the bioeffects document identifies as producing potentially significant biological effects. (2) Low estimated cost to society (\$12 million, spread over six years). (3) Substantially lower than existing (but dated) OSHA guidance for occupational exposure based on a maximum SAR of 4.0 W/Kg. (4) Some states and cities are likely to establish standards more stringent than EPA guidance. As a result, guidance of even 1.0 W/Kg may be translated into much lower levels. (5) Small exposed populations (essentially zero).

b. Con: (1) Higher than recent occupational guidance recommended by ANSI (0.4 W/Kg). (2) Inconsistent with the current *draft* recommendations being prepared by the National Council for Radiation Protection and Measurement (NCRP) which recommends a maximum SAR equivalent to 0.08 W/Kg. [NCRP is a non-profit corporation chartered by Congress that collects, analyzes, develops and disseminates information and recommendations about radiation protection and radiation measurements, quantities and units.] (3) A 1.0 W/Kg SAR limit could lead to an estimated human "core" temperature increase of about 0.5 degree C; this increase could be significant under certain ambient heat and humidity conditions, especially for certain sensitive populations exposed to continuous doses for extended periods of time.

4. Base Proposal on a SAR of 0.4 W/Kg.

ORP's proposed guidance would be revised to conform to a SAR of 0.4 W/Kg.

a. Pro: (1) Relatively small cost to society (\$15 million, spread over six years). (2) In theory, fewer people would be exposed to higher SAR values since exposures between 0.4 and 1 W/Kg would be inconsistent with the guidance. (But since the number of people receiving an average SAR in this range is extremely small, the actual significance is uncertain.) (3) Below the level at which there are known adverse health effects in animals. (4) Consistent with ANSI's occupational guidance.

FROM THE FIELD

b. Con: (1) Could indicate to the public that levels above 0.4 W/Kg are dangerous whereas data indicate otherwise. (2) Inconsistent with other EPA actions in that it is below the no observable health effects level. (3) Could be perceived as inadequate because it permits public exposures at a level equal to the generally accepted occupational guidance by ANSI. (4) Could lead to heat stress for some temperatures and humidity conditions for *some* population groups (the young, the aged and those with cardiovascular disease), if these individuals remain within 100-200 feet of the facility for a continuous period of time. (5) No certainty that states and cities will adopt it; they could adopt a more stringent standard.

5. Base Proposed Guidance on a SAR of 0.04 W/Kg.

(ORP's proposal)

a. Pro: (1) Strongly protective of public health in relation to

Options 1-4 above. (2) Consistent with the usual practice of generally providing substantially more protective standards for the general public than those established for occupational exposures. (3) A 0.04 W/Kg SAR limit should protect against any thermally-related health effects in all human populations even under *adverse* temperature and humidity conditions, based on available data. It would result in a maximum estimated 2-to-4 percent increase over the basal metabolic rate.

b. Con: (1) Relatively high cost to society (\$39 million, spread over six years). (2) No known health benefit for costs incurred in setting a standard below 1 W/Kg. (3) Seems inconsistent with recent agency decisions in that it is well below the known observable health effects level. (4) No certainty that states and cities will adopt it; they could adopt more stringent standards.

UPDATES *(continued from p.8)*

Legislation...The California Assembly defeated bill number 3175 by 37-25, after the Ways and Means Committee approved the measure by a narrow margin. The committee-passed version was markedly different from the bill originally introduced by Assemblyman Tom Hayden (see *MWN*, May 1984). The amended bill, though weakened in many respects, still would have required employers either to shield terminals to block non-ionizing radiation emissions or to provide alternative work during pregnancy for operators; the bill also would have established a task force to determine how to protect VDT workers. Following the Assembly's vote, Hayden asked that the bill be sent back to the Labor Committee for further hearings. This motion was approved and new hearings are expected in the fall....In Connecticut, state officials, computer manufacturers and labor groups have agreed to form a VDT study task force, following the completion of a study required by a

1983 law (see *MWN*, June 1983). No meetings have been held yet, and no agenda has been prepared....Massachusetts legislators have added \$75,000 to the state's fiscal 1985 budget for a VDT health and safety study. Originally advocated by Representative Elizabeth Metayer as an amendment in the House of Representatives, the money will be used by the Department of Labor and Industries' division of occupational hygiene to "evaluate virtually every aspect of VDT work," according to a legislative staffer. The budget officially took effect on July 1, but no timetable has been set for the study....Representative Karen Clark introduced Minnesota's first VDT legislation earlier this year, but no action was taken on the measure. Bill number H.F. 2333 would have required employers to provide adjustable furniture and terminals, glare reduction procedures and annual eye examinations. Semiannual testing for radiation emissions "above allowable standards" and alternative work during pregnancy also were included in the legislation.

CONFERENCES

September 10-13: **4th International Conference on Dielectric Materials, Measurements and Applications**, University of Lancaster, England. Contact: Institution of Electrical Engineers, Savoy Place, London WC2R 0BL, England, (01) 240-1871, ext. 222.

September 10-13: **14th European Microwave Conference**, Liege, Belgium. Contact: Microwave Exhibitions & Publishers, Convex House, 43 Dudley Rd., Tunbridge Wells, Kent TN1 1LE, England.

September 17-19: **19th Annual Microwave Power Symposium**, Minneapolis Plaza Hotel, Minneapolis, MN. Contact: IMPI, Suite 520, 301 Maple Ave. West, Vienna, VA 22180, (703) 281-1515.

September 17-19: **37th Annual Conference on Engineering in Medicine and Biology**, Los Angeles Hilton, Los Angeles, CA. Contact: Patricia Homer, Alliance for Engineering in Medicine and Biology, Suite 402, 4405 East-West Hwy., Bethesda, MD 20814, (301) 657-4142. The **6th Annual Conference of the IEEE-Engineering in Medicine and Biology Society** will meet September 15-17 immediately before the ACEMB meeting.

September 17-21: **NATO Advanced Research Workshop on Interactions Between Electromagnetic Fields and Cells**, Erice, Italy. Contact: Professor A. Chiabrera, Biophysical and Electronic Engineering Dept., Via all'Opera Pia 11A, 16145 Genoa, Italy, (10) 311811.

September 18-21: **4th International Conference on Electromagnetic**

Compatibility, University of Surrey, Guildford, England. Contact: Institution of Electronic and Radio Engineers, 99 Gower St., London WC1E 6AZ, England, (01) 388-3071.

September 26-28: **International Symposium on Electrostatics — Applications & Hazards**, Polygon Hotel, Southampton, England. Contact: Helen Raquet, Oyez Scientific and Technical Services, Bath House, 56 Holborn Viaduct, London EC1A 2EX, England, (01) 236-4080.

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 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.