worries over microwave radiation hazards. The final EIS's for both locations are out. Each contains the controversial RF/MW bioeffects review prepared by the Battelle Human Affairs Research Center in Seattle. Dr. Joe Elder of EPA's Experimental Biology Division critically evaluated the document when it was released in draft form last spring, and concluded: "The authors did a poor job of reviewing and citing the literature and reveal a lack of scientific insight into the complexities of the biological effects of microwave radiation." The regional EPA office in Seattle would only release Elder's evaluation through a Freedom of Information Act request....The New York City Planning Commission has approved Hughes Aircraft Company plans for a Galaxy Satellite Station in the Spring Creek area of Brooklyn...The EIS for Teleport, a huge satcom complex sponsored by the Port Authority of NY and NJ and Merrill Lynch, should be out for review in August. Andrews & Clark of New York City is preparing the statement, with the radiation aspects handled by Ammann Whitney, also of NYC....The FCC has approved Comsat's planned satcom facility in western Pennsylvania. The Roaring Creek Earth Station received local approval from the Cleveland Township Zoning Board last year....Direct broadcast satellite service (DBS) has finally won FCC approval. Interim rules for DBS appear in the July 21 *Federal Register* (47 *FR* 31555)....Home Box Office has chosen Scientific Atlanta of Atlanta, GA to supply four uplink stations for a new satcom center it will build in Hauppauge, Long Island, NY....Scientific Atlanta will also provide new equipment for RCA's Vernon Valley facility in New Jersey...The FCC approved the private sale of transponders for satellites launched by Hughes Communications, RCA and Western Union Telegraph. Will RCA try another auction?....An Office of Technology Assessment report, *US Civilian Space Policy and Applications,* (GPO No. 052-003-00878-5), supports development of 30/20 GHz satcom systems. Funding for NASA's 30/20 GHz research program has been repeatedly cut. Now both the House and Senate have earmarked money for a test run of the satellite.

Standards...On July 30, ANSI's Board of Standards Review approved the new RF/MW exposure standard (C95.1-1982). *Microwave News* will run the full text of the standard next month....At a meeting in early June, the physical agents threshold limit values (TLV) committee proposed several changes to the ACGIH's RF/MW radiation standard, first proposed last year. (See *MWN,* September 1981.) Among the revisions was the addition of the following language: The TLV's "may be exceeded if the exposure conditions can be demonstrated to produce a SAR of less than 0.4 W/Kg as averaged over the whole body and spatial peak SAR values less than 8.0 W/Kg as averaged over any 1 gram of tissue. For example for frequencies from 3 to 30 MHz, the equivalent power density can be increased by a factor of 10 up to a limit of 100 mW/cm^2, if it can be assured that exposed individuals are not in contact with the ground plane." And: "At frequencies below 30 MHz, ungrounded objects such as vehicles, fences etc., can strongly couple to RF fields. For field strengths near the TLV, shock and burn hazards can exist. Care should be taken to eliminate ungrounded objects, to ground such objects, or use insulated gloves when ungrounded objects must be handled." The TLV, which would apply to radiation in the 10 kHz-300 GHz frequency range, remains on the ACGIH's Notice of Intended Changes and interested parties have a year to submit comments on the new proposal....After extended debate, Multnomah County, OR, adopted a general population RF/MW standard on July 20. At its most stringent, in the 30-300 MHz band, the standard specifies a maximum exposure of 200 uW/cm^2. The County Board of Commissioners had initially supported a more severe 50 uW/cm^2 limit but backed off in the face of strong opposition from local broadcasters. The standard, as approved, closely resembles the one proposed by the county's planning commission this spring (see *MWN,* May 1982)....In comments submitted to the Massachusetts Department of Public Health on its proposed RF/MW standard (see *MWN,* March 1982), the National Association of Broadcasters (NAB) argues that the regulation would impose "unrealistically stringent limits" and "unnecessary paperwork burdens" on broadcasters—especially those whose radiation levels come nowhere near the proposed ANSI standards. The NAB is worried about the impact of the Massachusetts standard on broadcasters who use electronic news gathering equipment. The NAB recommends that the proposal be amended to exempt facilities that contain RF machines with input power to the radiating device of up to 25 watts (instead of 7 watts) and those using portable equipment. The comments were submitted by Erwin Krasnow and Barry Umansky....Writing in the March 1982 issue of the *Journal of Microwave Power,* Professor Herman Schwan finds himself in "essential agreement" with the proposed revision of the ANSI standard. In his analysis, Schwan considers only thermal effects.

Technology...NBS is working on ways of probing oil shale with RF energy to discover the ratio of rubble-to-void in underground caverns. A new report, *Modeling of Oil Shale Retorts for Electromagnetic Sensing Techniques* (No. NBSIR 81-1653), is available from NTIS, Springfield, VA, 22161 for $7.50. (Order No. PB82-153321.)...NBS scientists working at DOE's Energy Technology Center in Laramie, WY, have applied such RF techniques to accurately measure the dielectric properties of oil shale samples at 500°C over the 5-1000 MHz frequency range....On another energy front, researchers at the Southwest Research Institute (SwRI) in San Antonio, TX, have devised a way to automatically and continuously monitor the flow and quality of coal in boiler feed pipes using NMR and ESR technology. SwRI did the work under contract from a DOE technology center in Morgantown, WV....David Rust and Richard Doviak of NOAA's National Severe Storms Laboratory in Norman, OK, review the use of weather radar to study thunderstorms and lightning in the June 10 *Nature*....Tideland Energy, a company developing solar technology in New South Wales, Australia, have supplied solar power systems for 22 microwave repeater and terminal stations to the Department of Posts and Telecommunications in Papua, New Guinea.

VDTs...A VDT operator in San Francisco has received a workers' compensation award for job-related eye problems. This June, Sybil Barker won standard temporary disability benefits from her employer's insurance company two weeks before a scheduled Workers' Compensation Board hearing on her claim. Barker developed severe eye pains after three months at an architectural firm and was fired when her doctor told her not to return to the VDT....A booklet rating ten VDT models for health and safety features is now available from The National Association of Working Women. *The Human Factor: 9 to 5's Consumer Guide to the Health and Safety Features of Word Processors* includes an evaluation chart and recommendations to employers, manufacturers and public officials. Copies are $5 for institutions and $1.50 for individuals from the association, 1224 Huron Road, Cleveland, OH 44115....VDTs will be part of a NIOSH study of chronic stress in the office. The study design is currently being scaled down due to a 67 percent cut in funding. For more information, contact NIOSH's Barbara Cohen, Division of Biomedical and Behavioral Sciences, (513) 684-8386....The Ontario provincial legislature has defeated a VDT safety bill proposed by New Democrat Richard Johnson. (See *MWN,* December 1981.)...Concerns over possible ELF radiation hazards and the risks to pregnant women were the major subjects of discussion at the *International Forum on Low-Level EM Radiation and the Question of VDTs* held in Ottawa on June 4. The proceedings of the forum are being prepared and will be available from: The Planetary Association for Clean Energy, 100 Bronson Avenue, Ottawa, Ontario K1R 6G8, Canada, (613) 236-6265. Audio cassettes are also available....Delegates at the annual Newspaper Guild Convention in July called for immediate bioeffects research on the low frequency radiation emitted by VDTs—in both the ELF and VLF bands....Newspaper Guild President Charles Perlik, Jr., has written to NIOSH Director Dr. J. Donald Millar urging more research be done on 15 to 125 kHz radiation....VDTs are not the only source of low frequency radiation stirring up controversy. Hawaiians are worried about the Coast Guard's Omega navigational system, which radiates signals in the 10-14 kHz band—about the same frequency as that of a VDT flyback transformer. (See story on p. 3.)..The Labor Council of Metropolitan Toronto has launched a quarterly VDT newsletter. Subscriptions are $5 a year from the council's VDT Committee, Room 407, 15 Gervais Drive, Don Mills,

Ontario, Canada....Langley-St. Clair Instrumentation Systems Inc. of New York City is marketing a VDT screen X-ray shield. I-Protect, a leaded acrylic sheet fastening to the front of the terminal, comes in two sizes and sells for $50 to $60. For information, call (800) 221-7070. (*MWN* does not endorse commercial products.).... In a paper prepared for the BEMS meeting (see p. 1), Charles Wallach of Decisions and Designs Inc. in McLean, VA, suggests that ion imbalances in the air around operators and VDT screens could cause a number of health problems.... Norwegian researchers found PCB levels in offices with VDTs that were 50 to 80 times greater than levels outdoors. According to a report in the *International Archives of Occupational and Environmental Health,* Volume 49, p. 193, 1982, by Vemund Digernes and Erle Astrup of the University of Oslo, workplace air samples had PCB concentrations of 56–81 ng/m³. PCB's cause cancer in experimental animals. The authors hypothesize that VDT capacitors and transformers may be the source of PCB's and recommend further investigation of the terminals.... Are you a cyberphobe? The June 8 *Wall Street Journal* reports on Professor Sanford Weinberg's research indicating that up to 30 percent of US office workers suffer from cyberphobia, the fear of computers. Weinberg is at St. Joseph's University in Philadelphia, PA.

BEMS *(continued from p. 1)*

Calcium efflux research emerged as a new growth industry. A number of researchers, following the lead from Drs. Ross Adey and Carl Blackman, are trying to extend and explain what is known about the frequency and power windows that govern the movement of calcium in the brain.

Blackman reported that he was taking the amplitude modulation to higher ELF frequencies — multiples of the 16 Hz window first identified by Adey and Dr. Suzanne Bawin. Blackman and his co-workers at EPA's lab in Research Triangle Park, NC, found no effect at 30 Hz, but they did measure a response at 45 Hz and 50 Hz. In the process, they uncovered one interesting new dimension to the window phenomenon: power windows appear to become narrower as the frequency increases. At 45 Hz they measured significant calcium changes at 35–50 V/m, but at 50 Hz the power window had shrunk to 45–50 V/m.

Before completing his presentation, Blackman preempted the obvious question: Is there a window at 60 Hz, the power line frequency? That experiment, he said, had not yet been run.

In the one non-technical paper on the program, Professor Nicholas Steneck, a historian at the University of Michigan in Ann Arbor, took aim at the new American National Standards Institute (ANSI) safety standard. He called the final product pro-industry and warned that it "will not attract more supporters than did the old 10 mW/cm² standard."

John Monahan of the Bureau of Radiological Health perplexed his audience with the preliminary results from his experiment involving both the permeability of the blood brain barrier (BBB) and microwave-drug synergy. He injected mice with scopolamine and then exposed them with 2450 MHz radiation at an average SAR of 10 W/Kg for 30 minutes. He saw no leakage through the BBB and, surprisingly, found that microwaves wiped out, instead of enhanced, the effect of the drug.

Describing a three generation study of rats exposed to 80 kV/m, 60 Hz electric fields, Dr. Debbie Majeau-Chargois of Tulane University in New Orleans said that her team had found significant changes in white blood cells (but not red cells) and in the paired organs such as kidneys and testes. In an interview, she said that the overall pattern was one of reaction to "mild stress."

Members of Dr. Bill Guy's group presented progress reports on their three-year, low-level exposure study at the University of Washington in Seattle. Nearly all the tests made after 21 months of exposure revealed no difference between the exposed animals and the controls. One variation was in a few of the screening tests—the significance of this finding will have to await further results. There was also an increase in malignant neoplasia among the exposed animals, but as Dr. L.L. Kunz warned, much more data must be collected before any inferences can be drawn.

The BEMS conference was held the week of June 28 in Los Angeles, CA. At the society's membership meeting, Guy was elected the next president of BEMS.

VDTs *(continued from p. 1)*

called for a moratorium on introducing more VDTs into provincial hospitals. This position puts it at odds with the provincial ministry of health, which is pressing for widespread automation in hospitals.

The cluster at Surrey Memorial has fueled the already intense controversy over VDT safety, though neither federal nor provincial health officials have indicated that potential VDT radiation hazards require investigation. A number of Canadian study groups are looking into the problem, however.

• The Task Force on Micro-Electronics and Employment was briefed on the Vancouver cluster at a hearing last month. Murray Hardie, executive director of the five member group, said the union's report "shows there are potential health problems that have to be addressed. The absence of sound scientific research in this area is a problem." The task force, established by Labor Canada this March with a $300,000 budget, is focusing on job displacement and health problems created by new office technology. It plans to publish its report and recommendations early this fall.

• A subcommittee of a $12 million federal project to develop prototypes for the office of the future will review existing VDT studies and could recommend that a new study be done. According to Phil Kinsman of the federal Department of Communications, which is coordinating the project, the group will review radiation issues because "at this point you just can't avoid them." Kinsman said VDTs will be designed to meet user specifications and will be tested for radiation as part of the project. In addition to government funds, two major participating business consortiums will spend over $50 million on research and development of office systems.

• The VDT task force set up last year by the Ontario Ministry of Labor's Advisory Council on Occupational Health and Safety (see *MWN,* December 1981) is now looking at potential reproductive hazards. According to task force chairman Dr. Gordon Stopps at the University of Toronto, this issue was added to the group's agenda because of "the upsurge in interest and the number of reported clusters." Stopps hopes the group's report will be ready in September.

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Time Windows in Bioeffects Research

Time is emerging as a key variable in the study of the biological effects of non-ionizing radiation. A number of important studies reported at conferences in June indicate that the duration of exposure and the time at which a response is measured can be crucial in detecting a biological effect. Researchers are beginning to talk of "time windows" to complement the already well documented frequency and power windows.

In the course of radiating a biological system, "there is a complex sequence of events at work, and if you don't time it right you might fail to observe an effect," Glen Rein explained during a break at the Bioelectromagnetics Society (BEMS) annual meeting in Boulder, CO, June 12-17. Rein, a researcher at St. Bartholomews Hospital in London, England, said that "the postulated time windows offer a good explanation for the inconsistency and absence of bioeffects in the literature."

Dr. Ross Adey of the VA Medical Center in Loma Linda, CA, spoke of "windows in time" at the *International Conference on Nonlinear Electrodynamics in Biological Systems* which he hosted the week before the BEMS meeting. "We are gradually learning about how membranes can achieve induced and persistent molecular states," he told *Microwave News*. The lifetime of such states could determine how a radiation-induced effect may be observed. Indeed, the effect may only show up at some later time or even in a later generation of cells, Adey said.

Dr. Przemyslaw Czerski of the Food and Drug Administration's National Center for Devices and Radiological Health commented that the importance of the time variable in studying living systems is not news for biologists. This trend, he said in an interview after the BEMS conference, represents "a move toward a biological rather than an engineering approach" within the electromagnetic research community.

Microwaves and the Cornea

Studies on the eye being carried out at Johns Hopkins University's Applied Physics Lab demonstrate the importance of time windows. A team led by Henry Kues has found that pulsed 2.45 GHz microwaves can affect the endothelial layer of the cornea in primates at average power levels of 10 mW/cm^2. But cellular abnormalities only occurred 24-72 hours *after* a four-hour exposure. Kues discovered that he would not see an effect until the latency period had elapsed.

Although there has been some discussion about this microwave effect on the eye during the last 18 months (see *MWN*, January/February and May 1982), Kues's paper at the BEMS meeting and a similar presentation at the Loma Linda conference by Dr. Sam Koslov, also of the Johns Hopkins Lab, mark the beginning of what promises to be a long public debate. The effect is occurring at a relatively low power level and there is already speculation that it will force a reassessment of health standards. For example, the new American Conference of Governmental Industrial

(continued on p. 2)

Time Windows *(continued from p.1)*

Hygienists standard, adopted in May, is 10 mW/cm² at 2450 MHz.

In the meantime, Kues and his colleagues will be busy explaining and extending their results. They plan to run experiments at lower power levels, down to 5 mW/cm², and at higher frequencies, probably at 9 GHz, in search of a threshold for the effect. They will also look into two notable observations. First, pulsed radiation is about four times more effective in damaging the cornea than continuous wave (CW) radiation. According to Kues, to achieve the same effect as that found for pulsed signals at 10 mW/cm² requires 40 mW/cm² of CW microwaves. Second, they are detecting a new, unexpected, regeneration phenomenon in the cornea.

PEMFs and Time

At the non-linear meeting, papers by Rein and by Dr. Richard Luben of the University of California, Riverside, also indicated the presence of time windows. Rein's experiments on the action of a 500 Hz pulsed magnetic field on the release of noradrenaline from cultured PC12 cells (see *MWN*, May 1982), and Luben's experiments with various pulsed electromagnetic fields (PEMFs) on the adenyl cyclase system show effects that are strongly dependent on when the field is turned on and when the response is measured.

Similarly, Dr. Jose Delgado, who has demonstrated that extremely weak PEMFs can have a pronounced effect on the development of chicken embryos (see *MWN*, March 1983), has added a new twist to his findings. In an interview at the BEMS meeting, he said that unpublished data from his lab in Madrid, Spain, indicated that all embryos at a particular stage of development will be affected by PEMFs. But, he added, if you expose the eggs in the same way, and then allow them to develop for four to five more days, half of the embryos return to normal.

Dr. Betty Sisken of the University of Kentucky in Lexington reported that chick embryos with amputated limbs developed abnormally if PEMFs were administered immediately after amputation. If exposure to the signal was delayed for 24 hours after amputation, however, the embryos were immune to the PEMFs.

In and Out of the Field

The course of electromagnetic interactions over time may be significantly different from the typical dose-response relationship for chemical and physical agents. Adey and Dr. Craig Byus of the University of California, Riverside, have found a decrease in protein kinase activity in human lymphocytes after 15 to 30 minutes of exposure to a 450 MHz, amplitude modulated field. (This system exhibits the well known 16 Hz frequency window.) But they found no difference between the exposed cultures and controls after a 60-minute exposure.

The cultures adapt to the field in an hour, but not during shorter periods —indicating the presence of a narrow time window for stimulating a response. Biological systems are quite adaptable, but only if there is enough time for homeostasis. Adey draws the inference that going in and out of a weak field may be more detrimental than staying in it and adjusting to it. One facet still to be explored is whether the effect returns with prolonged exposures.

Prospects for Funding

There was a strong consensus at both the BEMS and Loma Linda meetings that the level of science within the bioelectromagnetic research community is more rigorous than ever before. Many are excited by the papers and by the prospect of finally understanding the mechanisms of interaction. The question on everyone's mind is whether there will be enough funds to pursue the new avenues of investigation.

At the final session of the Loma Linda meeting, Adey said that he had watched the slow growth of "credible scientific results" on the biological effects of electromagnetic fields, and it is now time to turn the research effort from the sphere of hazard analysis to the pursuit of a whole new set of scientifically acceptable tools and techniques. Only in this way, he said, can the research community be assured stable funding.

The prognosis for more research moneys remains bleak, however. As Koslov put it: "The role of the federal government to date in this critical field can be most kindly described as ranging from pathetic to abysmal." One indication of the poor prospects is that the National Science Foundation failed to send an observer to the Loma Linda meeting. Some of the organizers of that meeting are considering setting up an ad hoc committee to make the case for more research funds in Washington.

Plenum Press will be publishing the proceedings of the Loma Linda conference. A major effort is being made to expedite the process: all manuscripts were due on July 31 with a commitment from Plenum to have the book ready within 100 days. The model for such speed was set by Springer-Verlag, which issued the proceedings of an international symposium held in West Germany in record time; the meeting was held November 29-December 1, 1982 and the printed volume was already making the rounds at Loma Linda in the first week of June. (*Coherent Excitations in Biological Systems*, edited by H. Frohlich and F. Kremer, New York: Springer-Verlag, 1983, $25.50)

There were many other interesting papers presented at the BEMS meeting. Next month, we will feature an overview of new research on extremely low frequency (ELF), radiofrequency, microwave and millimeter radiation reported in Boulder.

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HIGHLIGHTS

EPA Releases RF/MW Bioeffects Review

The Environmental Protection Agency (EPA) has released its draft review of the biological effects of radiofrequency and microwave (RF/MW) radiation in the 500 kHz-100 GHz frequency range. The document will serve as the basis for limits on population exposures to RF/MW radiation, which EPA is scheduled to propose later this year.

The three-volume, 500-page review draft does not indicate what the future standard might be. The closest EPA comes to a recommendation is the following summary sentence: "Despite the recognizably incomplete state of knowledge in this area, the currently available information suggests that the biologically effective SAR [specific absorption rate] for mammalian systems lies in the range 0.4 to 6.0 W/Kg."

EPA does not specify how these SAR values would translate into power density limits. For comparison, the new American National Standards Institute (ANSI) RF/MW safety level is 1 mW/cm^2 between 30 and 300 MHz, based on the consensus that whole-body SARs below 4 W/Kg are not "associated with effects that demonstrably constitute a hazard."

Although the literature review was written by the staff at EPA's Office of Research and Development, the RF/MW standard will be set by the agency's Office of Radiation Programs (ORP). In a telephone interview, ORP's Dave Janes said that the standard is "still a moving target." One of the key variables still to be decided is how the agency will handle frequency dependence. A flat, ramp and well approach are all still in the running, Janes said.

Although EPA officials would not disclose what levels are now under consideration, the speculation within the RF/MW community is that the standard will be in the 100-200 uW/cm^2 range. The EPA limits, once promulgated, will only apply to federal agencies, and are known as a "guidance."

The first public discussion of EPA's draft document will come at a meeting of a special panel of the Scientific Advisory Board (SAB), chaired by Professor Charles Susskind of the University of California, Berkeley (see *MWN*, March 1983). The SAB panel is tentatively scheduled to meet in Washington, DC, on September 22-23. Public comments on the draft are due by September 16.

A copy of the EPA report, *Biological Effects of Radiofrequency Radiation,* (No. EPA-600/8-83-026A, June 1983, External Review Draft) is available from: ORD Publications — CERI-FR, US EPA, Cincinnati, OH 45268, (513) 684-7562. (Be sure to include the document number with your request.)

Wisconsin Sues Over Project ELF

The state of Wisconsin has filed suit to block the navy's Project ELF communication system until a new environmental impact statement (EIS) is prepared. On July 20, Wisconsin Attorney General Bronson La Follette charged in federal court that the navy had failed to revise its 1977 EIS to take into account changes in the proposed submarine communications antenna and new studies on environmental and health effects of extremely low frequency radiation (ELF).

La Follette and Assistant Attorney General Shari Eggleson cited a number of changes in the navy's ELF proposal including a small, suspended antenna instead of the originally planned larger buried antenna. The mode of transmission has also gone from a unified to a joint, synchronized system. In addition, the attorneys cited the publication of "numerous" new studies on the bioeffects of ELF radiation that "raise serious concerns."

A spokesman for the navy would not comment on the suit except to say that the navy will contest it.

The navy's Wisonsin facility at Clam Lake was deactivated by President Carter in 1979; in 1981 President Reagan decided to reopen, upgrade and expand it —adding two antennas in Michigan operated by a control center at K.I. Sawyer air force base (see *MWN*, May 1981 and March 1982). According to current plans, the navy intends to have the ELF system in operation by 1986.

The Secretary of Defense, Caspar Weinberger, and the Secretary of the Navy, John Lehman, Jr., the defendants in the suit, have 60 days from July 20 to respond to the complaint (No. 83C672C) filed in US District Court for the Western District of Wisconsin.

Meanwhile, on July 15 in neighboring Michigan, the Natural Resources Commission voted 5-0 in favor of granting the navy an easement to build the ELF antenna. Michigan Governor James Blanchard opposes the navy project as a "terrible waste of taxpayers' money," and asked the commission to turn down the navy request. Wisconsin's Eggleson told *Microwave News* that Michigan has been invited to join the Wisconsin suit but has not yet responded.

Stop Project ELF, a citizen's group based in both states, is considering court action to reverse the Michigan decision. The group's John Stauber said that the commission does not have the authority to give the navy permission to build the antenna. "Only the state legislature has that power," Stauber claimed.

Power Line Action in Montana and Florida

Montana has set a standard to limit public exposure to power line radiation, and similar regluations are planned in Florida.

Montana's Board of Natural Resources and Conservation recently established a 1 kV/m limit for electric fields at the edge of the right-of-way (ROW) in residential and subdivided areas along a planned 500 kV power line. To comply with the rule, the Bonneville Power Administration (BPA) will have to widen the ROW along certain sections of its Garrison, ND-Spokane, WA, line from 125 feet to 160 feet. Property owners may waive the requirement.

The board based its decision on recommendations from Dr. Asher Sheppard, its consultant on the biological effects

of power line radiation. Sheppard, a research physicist at the VA Hospital in Loma Linda, CA, concluded that the electric fields produced by a 500 kV transmission line "are sufficiently intense that regulations intended to limit chronic exposure are a prudent requirement." BPA maintained that there is no evidence that higher field strengths are hazardous. Along with the 1 kV rule, the board imposed a 50 dBA transmission line noise limit in populated areas. This will require a 205 foot ROW.

Copies of Sheppard's report, *Biological Effects of High Voltage AC Transmission Lines*, February 1983, and the final report of the Department of Natural Resources and Conservation, Energy Division, *Preferred and Alternate Routes for the Bonneville Power Administration's 500 kV Transmission Line From Garrison West*, April 1983, are available from K. Heart, DNRC, 32 South Ewing, Helena, MT 59620, (406) 449-4600.

Florida will tackle radiation hazards under revisions in its Transmission Line Siting Act, which passed the state legislature in late May. Statutes 403.52 - 403.536 of the measure authorize the Department of Environmental Regulation to establish public safety requirements for siting applicants. Since no funds accompanied the order, the department must make a 1984 budget request before beginning its work. The regulations will not apply to lines built under the state's Power Plant Siting Act. These lines link new generating facilities to the state power grid.

The state action grew out of a local battle to block construction of a Florida Power and Light substation in Tamarac. After successfully leading community opposition to the project, town resident Herman Bender petitioned the governor and the legislature for state-wide regulations for power line radiation.

NAS Panel Finds VDTs Safe

The National Academy of Sciences (NAS) panel studying effects of video display terminals (VDTs) on workers' vision has concluded that VDTs are safe. The panel strongly discounted the possibility that radiation emissions from terminals could cause eye damage, including cataracts.

The Panel on the Impact of Video Viewing on Vision of Workers did not address radiation risks for fetuses in its report, *Video Displays, Work, and Vision*. Neither did the panel consider very low frequency (VLF) radiation emitted by flyback transformers which some researchers believe may be dangerous.

The panel concluded that radiation emissions from VDTs "are highly unlikely to be hazardous" to health. On the basis of its review of seven studies completed between 1977 and 1981, the panel found that "emissions of all types of electromagnetic radiation —X-rays, ultraviolet (UV), visible (light), infrared (IR), and radiofrequency (RF) radiation, including microwaves— are well below accepted occupational and environmental health and safety standard limits." The report states that the panel did not try to assess the adequacy of these standards.

The panel challenged the 10 cases of VDT-related cataracts reported by Dr. Milton Zaret, a Scarsdale, NY, ophthalmologist. Only four of those cases involved "significant lenticular opacities," according to the report, "and each of them had known preexisting disease or exposure to cataractogenic agents." The six other cases involved "inconsequential opacities that did not appreciably reduce visual acuity," the report says.

In a telephone interview with *Microwave News*, Zaret said that the panel never contacted him and that he had not seen its final report. But he contested the panel's conclusions on the basis of media coverage. He said he sees "more and more people who are being injured by radiation" from VDTs. "Not a week goes by that I don't see that the problem is worse than I originally thought," he said.

The panel found that visual problems commonly experienced by VDT workers varied with the quality of equipment, workstation design, and the nature of the task. The most common difficulties reported by the panel were blurred vision, tired eyes, muscular aches and stress. The report recommends that employers pay closer attention to designing jobs and workstation environments that improve worker comfort and reduce job-related stress.

A spokeswoman for 9 to 5, the National Association of Working Women, told *Microwave News* that a VDT telephone hotline run by that group is producing evidence in "complete contrast to the conclusions of the report." Janice Blood said that early results from the hotline indicate a need for further research.

She also said that the report's conclusions probably will delay additional research which she maintains is already overdue. Of the 3,012 calls received in the hotline's first month, 17 percent were related to eye and visual problems, 10 percent to pregnancy concerns, 8 percent to headaches, and 5 percent to muscle strain.

Spokesmen for The Newspaper Guild and the Communications Workers of America also were critical of the report.

The Panel on the Impact of Video Viewing on Vision of Workers was formed by NAS in the spring of 1981 in response to a request from the National Institute for Occupational Health and Safety (NIOSH) to evaluate available research on visual health problems associated with VDTs. The panel, chaired by Professor Edward J. Rinalducci, a psychologist at the Georgia Institute of Technology, held a public symposium in Washington, DC, in August 1981 as part of the study (see *MWN*, September 1981). A summary of those proceedings is published in *Behavior and Information Technology*, Vol.1, No.2, 1982.

VDTs Dropped from California Epidemiological Study

Contrary to statements made in June by the National Institute for Occupational Safety and Health (NIOSH), an epidemiological study of pregnancy outcomes among video display terminal (VDT) users is *not* underway. The agency's plan to collect information through a project headed by Kaiser-Permanente, one of California's major health care companies (see *MWN*, June 1983), fell through in July.

NIOSH staffers now say the agency is likely to launch its own study.

Dr. David Brown, assistant chief of NIOSH's Industry Wide Studies Branch, told *Microwave News* that "the California study is a moot point now, but the VDT-pregnancy issue is important enough for us to go ahead and do our own study." NIOSH hopes to identify a suitable study population by this fall. Both Brown and Dr. Jane Gordon, the VDT project supervisor, are optimistic that NIOSH will fund a full-scale investigation in fiscal year 1984, which begins in October.

Although NIOSH's Dr. Michael Rosenberg said he had reached an agreement with Kaiser early this summer, the company decided against adding the agency's proposed question on VDTs to its questionnaire. Rosenberg recently left NIOSH to work for Family Health International in Research Triangle Park, NC.

Kaiser is collecting data for California's Department of Health Services on the reproductive effects of malathion, the pesticide sprayed to combat medflies. According to the project's principal investigator, Dr. Diane Pititti, the study will also investigate a limited number of other topics, but not VDTs.

Standards and Litigation at IMPI

Professor Herman Schwan sought to clarify the history of the early development of radiofrequency and microwave (RF/MW) safety standards in his keynote address at the 18th Annual *Microwave Power Symposium*, in Philadelphia, July 19-21.

Looking back to the late 1950's and early 1960's, Schwan said that he wanted to deflate four myths: First, that there was no interest in non-thermal effects during the Tri-Service research period. Second, that there was no research on non-thermal effects at that time. Third, that there was no interest in Soviet research. And fourth, that there was a conspiracy to ignore RF/MW bioeffects.

"Some have accused us of neglecting non-thermal effects," Schwan said, "but nothing could be further from the truth." Schwan, who chaired the subcommittee that recommended the first American National Standards Institute (ANSI) safety limit (the 10 mW/cm^2 standard adopted in 1966), recalled that there was no pressure from industrial and military groups —only scientific considerations went into formulating the standard, he said. He went on to note that the new ANSI standard "is a logical extension of the early standard." Schwan recently became a professor emeritus at the University of Pennsylvania in Philadelphia, but he will continue to teach and do research there.

Professor Nicholas Steneck a historian at the University of Michigan in Ann Arbor, took a different position. "RF bioeffects research has over the years been adversely affected by its dependence on the development community, namely industry and the military," he told the same crowd that had just heard Schwan. Judging bioeffects research to be "biased in very pronounced ways," Steneck urged that "politics and social maneuvering" be avoided so that the field be allowed to develop on its own, free of the constraints that have proven to be so controversial.

Steneck was particularly critical of the RF/MW research community for not using accident reports to assess human health impacts. As an example he cited the lack of follow-up on the death of a Hughes Aircraft employee who died in 1953 most probably from exposure to microwaves. "The contention that no one is dying or even being injured is not a statement that has the weight of science behind it. It is a statement that reflects, basically, the faith of the RF/MW bioeffects research community," he said. Steneck is completing a book on the development of RF/MW standards.

Marc Moller, an attorney with Kreindler and Kreindler in New York City, told the conferees that with the proliferation of microwave technology in industry, medicine and the home, "an increase in personal injury claims and litigation is a virtual certainty." Moller was the lead attorney on behalf of Robert Engell, a TACAN repair mechanic who developed pancreatic cancer. The suit was settled last December but details on the settlement were not divulged (see *MWN*, January/February 1983).

While noting that the question of causation —relating injury to microwaves— varies from case to case, Moller said "some plaintiffs, in my judgment, will inevitably be able to meet the 'reasonable preponderance of the evidence test' required to obtain favorable litigation results."

ANSI C95 Goes Back to Work

At the first meeting of the American National Standards Institute (ANSI) C95 Committee on Radiofrequency Radiation Hazards since the approval of the new safety standard (C95.1-1982) last year, Dr. F. Kristian Storm presented an ambitious plan for revising the standard. According to ANSI rules, all of the institute's standards must be updated every five years, and as Storm noted "the clock is running."

Under Storm's plan, the C95.IV subcommittee would set up five new task groups: to scan the world literature for new reports, to evaluate their engineering, biological and statistical validity and to assess their implications for exposure risks. The data will flow through these groups to Storm and the members of his C95.IV subcommittee. The review process is already under way.

Among the other C95 subcommittees, there were the following developments:

- NBS' Dr. Ray Baird reported that his subcommittee (C95.I) on instrumentation had decided to combine two existing ANSI standards on far-field (C95.3-1979) and near-field (C95.5-1981) measurements into one document. A new task group, under the direction of FDA's Howard Bassen will decide the best way to consolidate and update them. One suggestion for the revision is to place a greater emphasis on the measurement of magnetic fields.
- Baird's subcommitee will study the possibility of addressing dosimetric techniques.
- Dr. John Osepchuk, the chairman of subcommittee II/III on terminology and units, reported that no one, including

the navy, had yet printed the new non-ionizing radiation warning signal (C95.2-1981, see *MWN*, October 1981). Although this subcommittee has no detailed plans for the immediate future, Osepchuk did suggest that C95 should revise its vocabulary to make it consistent with that of the ANSI C63 committee on electromagnetic compatibility.

• In the next few months a new standard covering electroexplosive devices, prepared by subcommittee V under the chairmanship of Ramie Thompson, will be ready for circulation to the full C95 committee.

• Dr. Paul Tyler's medical surveillance subcommittee (C95.VII) called for volunteers to assist him in determining the medical tests that should be administered to RF/MW workers, and to help him decide how to address the problem of defining who are RF/MW workers.

At the meeting, Storm presented a tentative roster of experts who will serve on the new C95.IV committees and task groups: *Committee for Literature Surveillance,* Chair: Louis Heynick. *Committee for Engineering Principles Validation,* Chair: Bill Guy; Working Groups: 3 kHz-3 MHz: C.K. Chou, 3 MHz-300 MHz: O.P. Gandhi, 300 MHz-100 GHz: R.A. Tell. *Committee for Biologic Principles Validation,* Chair: Don Justesen; Working Groups: Behavior: J. D'Andrea, Biorhythm: R. Smith, Cardiovascular: J. Lords, Nervous System: R. Lebovitz, Development & Teratology: M. O'Connor, Endocrine: S. Lu, Visual: R. Carpenter, Genetics: C. Blackman, Acoustic: K. Foster, Hematology & Immunology: R. Smialowicz, Metabolic & Thermoregulation: E. Adair, Physiology: R. Phillips, Oncology: J. Dickson, Compound Interactions: P. Czerski. *Committee for Statistical Validation,* Chair: Carol Newton. *Committee for Evaluation of Exposure Risk,* Chair: Dave Janes.

Storm, an associate professor of surgery in the Division of Oncology at the UCLA Medical Center, took over as chairman of the C95.IV subcommittee after Dr. A.W. Guy resigned when the new health standard was approved. Raytheon's Osepchuk will serve as the secretary of the subcommittee. Professor Saul Rosenthal of the Polytechnic Institute of New York continues to serve as the chairman of the parent C95 committee.

NBS Calibration Program

The National Bureau of Standards (NBS) has announced the formation of an accreditation program for laboratories that measure microwave power, attenuation and reflection coefficients. NBS expects to certify the first labs under the National Voluntary Laboratory Accreditation Program (NVLAP) by the spring of 1985.

Labs that are found to have the necessary expertise and competence will join the NVLAP for electromagnetic calibration services. In order to win accreditation in the LAP, labs must participate in at least one of three Measurement Assurance Programs (MAPs): power, attenuation and reflection coefficient, all in the frequency range 0.1-18 GHz.

The decision to formally set up the new LAP stems from a 1977 request by Bruno Weinschel of Weinschel Engineering in Gaithersburg, MD. In early 1982, NBS announced its decision that labs providing electromagnetic calibration services should be accredited. In July 1982, some 46 representatives from government agencies and the private sector attended an NBS workshop in Boulder, CO, to help develop the LAP.

For more information, contact Douglas Thomas, project leader for the EM NVLAP or John Locke, manager of laboratory accreditation, NBS, TECH B141, Washington, DC 20234, (301) 921-3431. NBS' announcement for the new EM LAP appears in the June 30 *Federal Register,* (48 *FR* 30174).

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UPDATES

BIOLOGICAL EFFECTS

Literature Surveys... The *Biological Effects of Non-Ionizing Electromagnetic Radiation: A Digest of Current Literature* is back in print. Volume VII, Number 1, covering the period from January to June 1982, was published in June and the next issue is due out soon. The quarterly BENER digests had stopped appearing after NTIA and ERMAC ran out of funds. The Office of Naval Research (ONR) came to the rescue with a three-year contract to allow Bruce Kleinstein's Information Ventures, Inc., based in Philadelphia, PA, to continue the service. A limited number of copies are available from Dr. Michael Marron, ONR, Code 441CB, 800 North Quincy St., Arlington, VA 22217. Please include a mailing label....Louis Heynick and Dr. Peter Polson of SRI International in Menlo Park, CA, have prepared *Bioeffects of Radiofrequency Radiation: A Review Pertinent to Air Force Operations,* Report No. USAFSAM-TR-83-1. The 181-page analysis of the current bioeffects literature, commissioned by the air force (AF), is designed as a background document for environmental impact statements and assessments for installations that involve emissions of RF/MW radiation —for example the AF's west coast over-the-horizon radar and southeast PAVE PAWS radar system. Those seeking a copy should contact James Merritt, USAF School of Aerospace Medicine, Brooks AFB, TX 78235. According to Polson, the report will be updated from time to time as a function of AF needs and available funding.

COMMUNICATIONS

FCC RF/MW Rules... At a meeting in mid-September, the FCC will decide how to proceed with its proposed rules (issued January 1982) on the evaluation of radiation hazards in its licensing procedures for RF/MW sources. The commission has completed its review of the 18 sets of comments from the broadcasting and communications industries and is now considering various policy options (see *MWN,* March and September 1982)....Meanwhile, the FCC's Office of Science and Technology has published a revised edition of its report, *Questions and Answers About Biological Effects and Potential Hazards of Radiofrequency Radiation,* OST Bulletin No. 56, second edition, June 1983. A copy is available from the commission's Consumer Assistance Office, Washington, DC 20554, (202) 632-7000.

COMPATIBILITY & INTERFERENCE

Immunity Task Group... The task group studying ways of enhancing the immunity of home electronic equipment met in Washington on July 26. Hector Davis of the FCC Labs has joined the group, which is chaired by Don Heirman of American Bell. Davis is preparing an internal FCC report on the immunity of TV sets. The Electronic Industries Association's (EIA) Consumer Electronics Group is going forward with immunity measurements of 18 TV sets and two VCRs from ten manufacturers. And the American Radio Relay League (ARRL) is completing a questionnaire that should pinpoint the most common RFI problems. At a meeting on June 23, the IEEE Standards Board welcomed the progress being made by the task group toward voluntary standards, avoiding the need for mandatory rules. The board set the following priority list: TV receivers, VCRs and related equipment, hi-fis, telephones, home computers, home security devices (detectors and alarms), home appliances and other electronic devices with microprocessors. The group's next meeting will be the week of the EMC annual symposium in late August. Heirman intends to continue the current schedule of meeting every four to six weeks.

EMC '83... Everything is set for the *1983 International Symposium on Electromagnetic Compatibility.* While the conference runs from August 23 to 25, workshops on EMP and shielding are scheduled for Monday the 22nd and a number of IEEE, ANSI, EIA and SAE meetings will also be held on Monday and on Friday the 26th. It will be a busy week, with six workshops and 23 paper and poster sessions. Attendance should be good: by the end of July, the Hyatt-Regency Crystal City Hotel was fully booked, forcing EMCers to neighboring hotels.

Reports, Products and Contracts... The FCC's Office of Science and Technology has issued two Technical Memorandums, "Teletext Related Interference Observed on WETA-TV, Washington, DC" (No. FCC/OST TM 83-2) and "Diurnal Variation in MF Skywave Propagation" (No. FCC/OST TM 83-4). The first describes the potential problems facing broadcasters when transmitting teletext information. The second details the ways in which daytime stations can expand their time on the air without causing interference to stations already authorized to broadcast during the sunset-sunrise hours. Both reports are available from the Downtown Copy Center, 1413 K St., NW, Washington, DC 20037, (202) 289-4140....A group from EPA, Southwest Research Institute and Electro-Metrics describes a new under-the-hood antenna system for measuring electric and magnetic fields from an automobile ignition system in the May *IEEE Transactions on Electromagnetic Compatibility.*...Dow Jones, the publisher of the *Wall Street Journal* has shielded its 11-meter satellite communications antenna in Highland, IL, from RFI with precast concrete panels made by the Fanwall Corp. of Arlington, VA. The 35-foot high, 72-foot long shield reduced the strength of an interfering terrestrial signal by 14 dB. The shielding wall can withstand winds of up to 100 mph....Keene Corp.'s Ray Proof Division in Norwalk, CT, has introduced a special shielding system to protect NMR imagers from RFI. The Series 84 enclosures can provide isolation from RF noise, reducing it 100 dB between 1 and 100 MHz....Comsearch Applied Technology has opened a field office in Annapolis, MD, to support EMC projects for the navy....The navy has awarded a one year, $893,044 contract to Bendix Field Engineering of Columbia, MD, for electromagnetic environmental effects and RF systems performance analysis. And Rome Air

Development Center at Griffiss AFB, NY, is negotiating with the Draper Lab in Cambridge, MA, for an analysis of the UHF and L-band interference threat for the late 1980's and 1990's.

GOVERNMENT

EPA's R&D Budget... In mid-July, the President signed HR 3133, which contains EPA's FY84 appropriations. The bill had emerged from a House-Senate conference committee with the House's $1 million line item for non-ionizing radiation health effects research deleted. Instead, the conferees agreed to add $4 million to the administration's original budget request —the one that planned to close EPA's RF/MW research program— for health effects research on air, drinking water, toxics and non-ionizing radiation (House Report No. 98-264, June 23, 1983). How the new money will be divided among these programs has been left up to EPA, though one House staffer was optimistic that agency officials would follow the recommendations of the House committees which called for more non-ionizing radiation research, especially at power line frequencies. It is not yet clear whether these funds are for extra-mural research or can be used to preserve the RF/MW group at EPA's Health Effects Research Lab in Research Triangle Park, NC. If the $4 million must be spent outside the agency, EPA could still save the lab by using some of the more than $24 million and 607 positions that Congress added to the EPA budget to be allocated at the agency's discretion. EPA Administrator William Ruckelshaus is scheduled to complete his EPA FY84 and FY85 budgets by mid-August. The fate of the RF/MW lab should be known then. Also, as we go to press, the *Washington Post* reports that Ruckelshaus has offered Professor Bernard Goldstein of Rutgers University the job of EPA Assistant Administrator for R&D. If Goldstein accepts he will replace Courtney Riordan who has been filling in on an acting basis.

FDA's Radiation Program Reorganized... The reorganization of FDA's National Center for Devices and Radiological Health is nearly complete: the plan has won the approval of FDA Commissioner Arthur Hayes, Jr., (who resigned on July 28) and the Assistant HHS Secretary for Health Edward Brandt. The center, with John Villforth as Director and James Benson as Deputy Director, is now operating under the new structure on an interim basis, with new appointees working in an "acting" capacity until HHS Secretary Margaret Heckler gives the final okay. As such, the Offices of Radiological Health and Medical Devices have been replaced by eight new offices. Four major ones: Compliance, Device Evaluation, Science & Technology and Training & Assistance; and four smaller ones: Health Affairs, Health Physics, Management & Systems and Standards & Regulations. The Office of Science & Technology, directed by Roger Schneider with Dr. Moris Shore as deputy director, has three new components: the Division of Physical Sciences (the same as BRH's old Division of Electronic Products) directed by William Herman; the Division of Life Sciences (the same as the old Division of Risk Assessment) directed by Dr. William Leach; and the Division of Biomedical Engineering (no director has yet been named). Howard Bassen will continue as chief of the electromagnetics branch in the new Division of Physical Sciences and Dr. Mays Swicord will serve as chief of the non-ionizing radiation branch in the Division of Life Sciences. Walter Gundaker is in charge of the new Office of Compliance, Robert Britain of the Office of Device Evaluation and Philip White of the Office of Standards & Regulations. When the plan is approved, a notice will appear in the *Federal Register.*

MEASUREMENT

New Narda Probe... Narda Microwave of Hauppauge, NY, has introduced a new electric field probe to simplify the measurement of radiation fields relative to the new ANSI RF/MW safety standard. The Model 8682 probe, when used in conjunction with the standard Narda 8611 or 8616 meter, will indicate exposure levels as a percentage of the ANSI guidelines —from 0.2 to 200 percent— by taking into account the frequency dependence in the ANSI limits. The probe costs $1250.

Dosimeter Expands... Dr. Wordie Parr, who resigned as chief of NIOSH's Physical Agents Effects Branch in Cincinnati, OH, at the end of last year has joined the Dosimeter Corp., also in Cincinnati, as products manager and consultant. While Dosimeter has been primarily involved with ionizing radiation, Parr plans to lead the company into the RF/MW instrumentation field.

MEDICAL APPLICATIONS

FDA Panel Smiles on BSD and NMR... Meeting in Rockville, MD, on July 6-7, the FDA's Radiologic Devices Panel recommended three NMR imagers and BSD Corp.'s hyperthermia unit be approved for marketing. The FDA must still accept the recommendation and give the final okay; the companies and the agency must agree on labelling language, which determines how the units may be used. The action on the BSD-1000 cancer treatment unit had been expected (see *MWN,* May 1983). NMR imagers made by Diasonics, Picker and Technicare are the first to receive clearance from the panel. The official FDA decision is not expected for about another three months, although action on the BSD unit could be a little quicker since the company has been negotiating with the agency for some time. The panel's action has put on hold a proposal by the National Electrical Manufacturers Association (NEMA) to reclassify NMR imagers from Class III to Class I or II (which do not require premarket approval)....NCI has awarded the Allegheny-Singer Research Corp. of Pittsburgh, PA, $1,654,712 for its hyperthermia quality assurance program, and the institute has issued a request for proposals (RFP 223-83-6032) for the development of educational guidelines and recommendations for hyperthermia operators.

Electric Fields Kill Pain and Affect RNA... Low frequency electrical fields are being used as anesthetics. Dr. William Bauer of the VA Medical Center in Cleveland, OH, has applied transcutaneous electrical nerve stimulation to treat severe head and neck pain among cancer patients. Writing in the June 1983 issue of *Archives of Otolaryngology,* Bauer reports that he achieved "extremely positive" results; the best frequency was between 0.5 and 8 Hz. Bauer used the Alpha-Stim 2000, developed by Dr. Daniel Kirsch and marketed by Electromedical Products Inc. of Hawthorne, CA. The unit costs $5,850; a smaller consumer (by prescription) model, the Alpha-Stim 350, is available for $995. (There are many other similar products on the market.) In a telephone interview, Bauer said that the use of electric fields is "opening up a whole new discipline in medicine." Bauer will soon be moving to Emory University in Atlanta, GA, where he will continue his work on pain as well as do research on the effects of electric fields on immunological and neurological diseases.... A team from Columbia University's medical school has found that two different pulsed electromagnetic fields (PEMFs) have different effects on RNA transcription. In a paper in the June 17 *Science,* Drs. Reba Goodman, Andrew Bassett and Ann Henderson describe their experiments with *Sciara Coprophila,* a fungus gnat, using single (72 Hz) and repetitive (15 Hz) pulses. While the single pulses increased the activity of messenger RNA after 15 and 45 minutes, the repetitive train of pulses increased activity only after 45 minutes. The authors conclude that their study "supports the hypothesis that PEMFs induce specific modifications in normal cell function."

OVENS

FTC-Amana Suit... The FTC has settled its 1982 suit charging Amana Refrigeration Inc. with falsely advertising its Radarange microwave oven (see *MWN,* November 1982). The commission maintained that company ads claimed an Amana oven was the only brand to pass an independent laboratory test, when in fact a Panasonic also passed. It also charged Amana with claiming a consumer survey rated its oven "best quality," even though many oven owners preferred other brands. Under a consent agreement, appearing in the July 18 *Federal Register,* (48 *FR* 32596), Amana, a Raytheon subsidiary, and its ad agency, Foote Cone & Belding, promise not to make these claims and to avoid misrepresenting any other surveys or tests. Amana officials say they entered the agreement, which carries no admission of guilt, to avoid lengthy and expensive legal action. Copies of the agreement and the original complaints are available from the FTC's Public Reference Branch, Room 130, 6th St. and Pennsylvania Ave., NW, Washington, DC 20580, (202) 523-3598. Comments on the agreement are due by Septmeber 16, after which the commission will decide whether to make the agreement final.

POWER LINES

Generally... Recent studies that link leukemia to low levels of ELF radiation from power lines (see *MWN,* March 1983) have caught the attention of Congress. According to Christopher Dodge of the Congressional Research Service (CRS) at the Library of Congress, CRS has received some two dozen inquiries about these studies from both Senate and House members. Dodge said he would not be surprised if hearings were held....DOE has released its *Draft Environmental Impact Statement, DOE/DEIS-0103, for the New England/Hydro-Quebec ±450 kV DC Electric Transmission Line.* Copies are available from Garet Bornstein, Office of Fuels Programs, Economic Regulatory Administration, Room GA-017, 1000 Independence Avenue, SW, Washington, DC 20585, (202) 252-5935....The Electric Power Research Institute (EPRI) has published *Measurement and Characterization of Substation Electromagnetic Transients,* final report (No. RP1359-2), March 1983, from the Texas A&M University. It is available from EPRI's Research Reports Center, PO Box 50490, Palo Alto, CA 94303, (415) 965-4081....CORRECTION: The title of another EPRI report, *Bipolar HVDC Transmission System Study Between ±600 kV and ±1200 kV: Corona Studies, Phase 2,* (No. RP430-2) was misreported in our June issue....A history of the ±400 kV DC transmission line cutting across Minnesota from North Dakota, a bitter siting controversy lasting nearly ten years, is featured in the July *IEEE Spectrum.* In his special report, Sheldon Mains of the Minnesota Environmental Quality Board maintains that the story holds important lessons for technical planners.

STANDARDS

RF Heaters in Canada... The Canadian government has proposed rules governing the design, construction and functioning of industrial RF heaters in order to limit radiation exposures to operators. The new amendment to the *Radiation Emitting Devices Regulations* specifies that stray fields measured 15 cm or more from the external surface of the heater shall not exceed: (i) a maximum electric field of 300 V/m; (ii) an effective electric field of 60 V/m; (iii) a maximum magnetic field of 0.8 A/m; and (iv) an effective magnetic field of 0.16 A/m. The rules also set limits for X-ray exposure. The regulations were proposed on March 30 and appear in the April 16 issue of the *Canada Gazette Part I.*

...Copies of the proposed new standard *Recommended Practice on Procedures for Control of System Electromagnetic Compatibility* No. BSR C63.12, are available for $6.00 from: Margaret Lynch, IEEE, 345 East 47th Street, New York, NY 10017....ANSI has approved a new set of definitions of radar terminology. Standard ANSI/IEEE 686-1982, *Radar Terms,* is available from ANSI, 1430 Broadway, New York, NY 10018. The price has not yet been set.

VDTs

Legislation and Regulation... Following legislative successes in Maine and Connecticut for supporters of VDT health and safety measures (see *MWN*, June 1983), state representatives in Oregon and New York plan to continue their efforts to enact VDT safety rules. Oregon State Senator Margie Hendriksen, whose VDT bill was not acted upon before the senate adjourned, told *Microwave News* that the Senate Labor Committee she chairs has recommended that a task force be established to study VDT health and safety issues. In a letter to the president of the Oregon Senate, the committee suggested the task force be directed to report to the senate when it reconvenes in 1985. New York State Assemblyman Frank Barbaro also announced his intention to reintroduce VDT safety legislation in the next assembly session. His legislation would require radiation shielding at the point of manufacture and guarantee pregnant women the right to non-VDT work. Barbaro appeared on the *Donahue* television show recently to discuss VDT health and safety concerns and state legislation. Also appearing were Karen Nussbaum of 9 to 5, Vico Henriques of CBEMA, Key Dismukes of the NAS Committee on Vision and Sue Waltz, a VDT worker. For a transcript of the show, send a check for $2.50 to Donahue Transcript, PO Box 2111, Cincinnati, OH 45201....Citing recent research findings of very low frequency radiation (VLF) health hazards from VDT flyback transformers (see *MWN*, November 1982, January/February and April 1983), the Newspaper Guild has called on the federal government to study possible VLF shielding. In its Officers' Report to the 1983 Newspaper Guild convention the guild urges "the appropriate government agencies" to develop specifications and cost estimates immediately for such shielding.

Studies in Progress... Researchers at the University of Texas, Austin, are at work on a study to establish an objective measure for visual fatigue among VDT workers. The project is scheduled to take four years to complete and is being led by Dr. A.J. Welch of the University's Departments of Electrical Engineering and Biomedical Engineering. Funding for the work comes from the IBM Corp., which has committed $382,000 to the study....The results of an epidemiological study of approximately 2,000 Newspaper Guild members (see *MWN*, March 1981) are expected soon. The study, coordinated by Dr. Arthur Frank at the Mount Sinai Medical Center in New York City, included eye examinations and a survey questionnaire involving seven locals of the guild. Frank recently left Mount Sinai to become Chairman of the Department of Preventive Medicine and Environmental Health at the University of Kentucky's College of Medicine in Lexington....Two University of Wisconsin, Madison, researchers are continuing their work on office automation problems. Dr. Robert Arndt is preparing a policy paper on office technology hazards due soon from the congressional Office of Technology Assessment (OTA). Arndt's presentation of differing views on potential health problems and available documentation will be released by OTA this fall and subsequently will be included in OTA's *Health and Safety Control Technologies in the Workplace*, a compilation of studies. Professor Steven Sauter, a colleague of Arndt's in the University's Department of Preventive Medicine, is studying the effect of automation on the nature of work in a project under contract to NIOSH. No date for the final report has been set....A new study looking at the impact of VDTs in the office will consider both ergonomic and radiation concerns. The *Project On the Workplace Impact of Video Terminals in the Office* began in April 1982 and is expected to cost between $250,000 and $300,000, according to its director, Professor Alan Westin of Columbia University. The research is being supported in part by IBM and Hewlett-Packard. The remainder of the funding comes from Westin's Educational Fund for Individual Rights....The Canadian Standards Association has set up a Technical Committee on Ergonomics to produce guidelines for workers and employers on office environment, workstation, equipment and furniture. Representatives from the Canadian Business Equipment Manufacturers Association and the Canadian Center for Occupational Health and Safety (CCOHS) will participate. Draft guidelines are scheduled for public review in early September and a final *Guidance on Ergonomics of the Office Environment* is due in December.

Resources...CCOHS has released a follow-up report to its recommendation early this year that radiation standards be extended to include the very low frequency radiation (VLF) emitted by some VDTs (see *MWN*, January/February 1983). *The Case for Concern About Very Low Frequency Fields from Visual Display Terminals: The Need for Further Research and Shielding of VDTs* is a 24-page document that argues the need for caution about VLF radiation at least until more is known. Also a pivotal Czechoslovakian study cited by CCOHS in making its recommendation has been translated into English and is available from the Center. Both the follow-up report and Czech researcher Dr. Hana Pafkova's finding of "an unfavorable effect" on embryonic development of pregnant mice exposed to a pulsed 300 Hz field with a peak value of 28,500 V/m and a pulse width of 10 microseconds can be obtained from CCOHS, 250 Main Street East, Hamilton, Ontario, L8N 1H6....The Canadian Department of National Health and Welfare recently released *Investigation of Radiation Emissions from Video Display Terminals* (see *MWN*, December 1982). The report concludes that, "There is no reason for any person, male or female, young or old, pregnant or not, to be concerned about radiation health effects from VDTs." Copies of the report, No.83-EHD-91, are available from: Public Affairs Directorate, Department of National Health and Welfare, 5th Floor, Brooke Claxton Building, Ottawa K1A 0K9....The highlights of the International Conference on Office Work and New Technology held in October 1982 (*MWN*, November 1982) are excerpted in *Office Automation: Jekyll or Hyde?* Copies cost $12.95 and can be ordered from Working Women Education Fund, 1224 Huron Road, Cleveland, Ohio 44115....The Canadian Advisory Council on the Status of Women has published, *Reproductive*

Hazards at Work: Men, Women and the Fertility Gamble, by Nancy Miller Chenier. In an early chapter this book-length study outlines reproductive hazards associated with VDTs. Other potential dangers discussed include chemicals, ionizing radiation, and psychosocial hazards. It is available free of charge from the Canadian Advisory Council on the Status of Women, Box 1541, Station B, Ottawa, Ontario, K1P 5R5.

ETC.

People...A number of changes are taking place among the leadership of the Bioelectromagnetics Society (BEMS). Dr. Bill Guy of the University of Washington, Seattle, took over as president of the society in June. The BEMS membership has elected Dr. Don Justesen vice-president, and he will take over as president when Guy steps down next year. Dr. Elliot Postow of the National Naval Medical Center in Bethesda, MD, will retire as editor of *Bioelectromagnetics* after completing the journal's fifth volume. Dr. R.D. Phillips of Battelle Pacific Northwest Labs in Richland, WA, will be the next editor of the BEMS journal; all manuscripts submitted for publication after January 1 should be sent to Phillips. And Dr. Michael Marron, who is replacing Dr. Tom Rozzell at the Office of Naval Research (ONR), will also assume editorship of the BEMS newsletter. Rozzell is off to ONR's office in London....At EPA's Health Research Lab in North Carolina, Dr. Claude Weil, who works on computer models of electromagnetic fields, is leaving the agency for Boeing in Seattle, WA....Dr. Eleanor Adair of the John Pierce Foundation at Yale University has been elected a fellow of the AAAS....And the Canadian Center for Occupational Health and Safety in Hamilton, Ontario, has formed a new section devoted to physical hazards. Dr. Karel Marha will serve as manager and Dr. Shelly Beauchamp as project scientist for the section, which will begin by focussing on the effects of non-ionizing radiation in general and low frequency magnetic fields in particular.

CONFERENCES

August 16-19: *2nd Annual Meeting of the Society of Magnetic Resonance in Medicine,* Fairmont Hotel, San Francisco, CA. Contact: SMRM, Radiology Postgraduate Education, Room C324, University of California, San Francisco, CA 94143.

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

August 23-26: *URSI International Symposium in Electromagnetic Theory,* Santiago de Compostela, Spain. Contact: Dr. J.L. Sebastian, Dept. de Electricidad y Electronica, Facultad de Ciencias Fisicas, Ciudad Universitaria, Madrid (3), Spain.

September 4-6: *URSI Symposium on Techniques in Studies of Biological Effects of Low-Level Millimeter Waves,* Herrsching, West Germany (near Munich). Contact: Professor Saul Rosenthal, Polytechnic Institute of New York, Route 110, Farmingdale, NY 11735.

September 5-8: *13th European Microwave Conference,* Messezentrum, Nurnberg, West Germany. Contact: Microwave Conference, Convex House, 43 Dudley Road, Tunbridge Wells, Kent, TN1 1LE, England.

September 6-8: *2nd International Conference on Radio Spectrum Conservation Techniques,* University of Birmingham, England. Contact: Conference Services, IEE, Savoy Place, London WC2R 0BL, England.

September 12-14: *36th Annual Conference on Engineering in Medicine and Biology,* Hyatt Regency Hotel, Columbus, OH. Contact: Alliance for Engineering in Medicine and Biology, 4405 East-West Highway, Suite 210, Bethesda, MD 20814.

September 19-21: *16th Annual Electronics and Aerospace Conference and Exposition,* Shoreham Dunfey Hotel, Washington, DC. Contact: Susan Vekich, Honeywell Inc., Aerospace and Defense, Honeywell Plaza, Minneapolis, MN 55408.

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

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

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 Street, 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 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.

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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) '84,* Aboard the Queen Mary, Long Beach, CA. Contact: Robert Myers, 1700 Westwood Blvd., Suite 101, Los Angeles, CA 90024.

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.

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

FROM THE FIELD

With this issue Microwave News *is introducing "From the Field," a monthly column featuring contributions of fact and opinion from our readers. We welcome short items of interest to the electromagnetic bioeffects and compatibility communities.*

"From the Field" offers you a quick way to communicate with your colleagues. There is no charge for this service, and we hope you will take advantage of it.

Of course, we continue to encourage our readers to submit letters to the editor on any relevant subject.

The opinions expressed in "From the Field" are those of the author(s) and do not necessarily represent the views of the editors of Microwave News.

Corrections From Battelle Pacific NW Labs

At last fall's Department of Energy contractors' review, Battelle's Dr. R.D. Phillips explained that a high-voltage transformer failed and was not correctly repaired: "The two high-voltage outputs, which are connected to adjacent electrodes in the mouse exposure system, were in phase rather than 180 degrees out of phase as specified." This resulted in lower field strengths than previously stated. The following two letters will be published in a forthcoming issue of Bioelectromagnetics. *We reproduce them here, at Battelle's request, to expedite the corrections in the papers cited.*

An erratum needs to be published in *Bioelectromagnetics* for the paper entitled, "Effects of 60 Hz Electric Fields on Specific Humoral and Cellular Components of the Immune System" 1982, *Bioelectromagnetics, 3,* 341-347 by J.E. Morris and R.D. Phillips.

A malfunction of the transformer used in this study was discovered after publication of this paper. The electric field strength in the mouse cages was 0.15-0.25 kV/m rather than 100 kV/m as reported in the publication. Experiments are planned to repeat this study at 100 kV/m.

James E. Morris, Ph.D.

An erratum needs to be published in *Bioelectromagnetics* for the paper by B.W. Wilson, et al. entitled "Chronic Exposure to 60 Hz Electric Fields: Effects in Pineal Function in the Rat" *Bioelectromagnetics, 2,* 371-380.

A malfunction of the transformers used for this study was detected subsequent to publication of this paper. The unperturbed field strength was 1.7-1.9 kV/m rather than 65 kV/m stated in the paper. A subsequent study at 60 kV/m produced essentially the same results as those observed at 1.7-1.9 kV/m.

Larry E. Anderson, Ph.D.

Biology and Chemistry Department, Battelle Pacific Northwest Laboratories, PO Box 999, Richland, WA 99352.

SHORT COURSES

August 26: ***The Understanding and Application of MIL-STD-461B,*** Arlington, VA. Fee: $295. Contact: R&B Enterprises, 20 Clipper Road, W. Conshohocken, PA 19428, (215) 825-1960.

August 29-30: ***Doppler Radar Meteorology,*** San Francisco, CA. Fee: $585. Contact: Technology Service Corp., 8555 16th St., Suite 300, Silver Spring, MD 20910, (301) 565-2970.

August 29-31: ***Engineering Techniques for Clinical Hyperthermia,*** Washington, DC. Fee: $685. Contact: Continuing Engineering Education, George Washington University (GWU), Washington, DC 20052, (800) 424-9773.

August 30-September 1: ***FCC & CISPR/VDE Compliance Design and Retrofit of Digital Devices,*** Newark, NJ. Fee: $760. Contact: Don White Consultants, Inc. (DWCI), State Route 625, PO Box D, Gainesville, VA 22065, (703) 347-0030.

September 12-16: ***Radar Systems Engineering,*** Washington, DC. Fee: NA. Contact: Continuing Education Institute (CEI) 10889 Wilshire Blvd., Los Angeles, CA 90024, (213) 824-9545 or (301) 596-0111. Repeated • September 19-23: Columbia, MD.

September 12-16: ***Spread Spectrum Communications Systems,*** Washington, DC. Fee: $855. Contact: GWU, see August 29 above.

September 13-15: ***EDP Equipment Design Seminar on Coping with the FCC/VDE Regulations on RFI,*** San Diego, CA. Fee: $695. Contact: EMXX Corp., 6706 Deland Drive, Springfield, VA 22152, (703) 451-4619. Repeated • October 11-13: Boston, MA; • November 8-10: San Francisco, CA.

September 18-24: ***Microwave Measurements,*** University of Kent, UK. Fee: 200-300 pounds, depending on IEE membership and housing needs. Contact: Institute of Electrical Engineering (IEE), Savoy Place, London WC2R 0BL, England, 01-240-1871, ext. 272 or 282.

September 19-21: ***Imaging Equipment Update,*** Chicago, IL. Fee: $150/$250/$300 for 1/2/3 days. (NMR and Nuclear Medicine on the 21st). Contact: Ms. Judy Gallegos, Dept. of Radiology, University of Utah School of Medicine, Salt Lake City, UT 84132.

September 20-23: ***Grounding and Shielding,*** San Diego, CA. Fee: $760. Contact: DWCI, see August 30 above.

September 26-29: ***Electromagnetic Compatibility Engineering,*** East Brunswick, NJ. Fee: $1160. Contact: Center for Professional Advancement, PO Box H, East Brunswick, NJ 08816, (201) 249-1400. Repeated • October 18-21: San Mateo, CA.

September 26-30: ***Electromagnetic Interference and Control,*** Ottawa, Canada. Fee: $855. Contact: GWU, see August 29 above. Repeated • December 12-16: Washington, DC.

September 27-29: ***Grounding, Bonding and Shielding,*** Nashua, NH. Fee: $695. Contact: R&B, see August 26 above. Repeated • October 3-5: Philadelphia, PA; • November 7-9: Atlanta, GA.

October 6-7: ***EMI and ESD Control in Electronic Systems,*** Philadelphia, PA. Fee: $495. Contact: R&B, see August 26 above. Repeated • October 24-25: Boston, MA; • November 10-11: Atlanta, GA.

October 10-11: ***International Requirements for EMI and Product Safety,*** Philadelphia, PA. Fee: $495. Contact: R&B, see August 26 above. Repeated • October 31-November 1: Boston, MA.

October 10-15: ***Advanced Microwave Circuit Design,*** Los Angeles, CA. Fee: $975. Contact: Short Course Program Office, UCLA Extension, PO Box 24901, Los Angeles, CA 90024, (213) 825-1295.

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, see August 26 above. Repeated • December 5-6.

October 17-21: ***Communications Satellite Engineering,*** Washington, DC. Fee: $855. Contact: GWU, see August 29 above.

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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/cm^2 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 injuction 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 Eggleson, 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 anomolous 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 margin of ten was then factored in. The frequency dependent exposure guidelines, 1 mW/cm^2 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/cm^2 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/cm^2 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 extremely 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/cm^2 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/cm^2 and routinely exposed to 5 to 10 mW/cm^2 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.

UPDATES

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)

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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 (uW/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 uW/cm^2 in the primary frequency range of interest (equivalent to a SAR of < 0.0004 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 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

[1]ORP 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.

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 OBL, 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 Horner, 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.

MICRO WAVE NEWS

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RF and VLF Radiation Hazards Reappraised

The health risks associated with exposure to 30-70 MHz radiofrequency (RF) radiation are greater than previously believed, according to Professor Om Gandhi of the University of Utah. This new finding, together with previous research on shocks and burns from very low frequency (VLF) fields (300 kHz-3 MHz), could force a reappraisal of the adequacy of current safety standards, possibly leading to changes in the operation of broadcast transmitters and of industrial machinery such as RF sealers and heaters.

Gandhi has found that a 1 mW/cm² 40 MHz field induces a maximum current of 780 milliamps (mA) through the ankles in a free standing adult. Gandhi estimates that the resulting local specific absorption rate (SAR) in the ankles is 243 watts per kilogram (W/Kg). Such "hot spots" may present a risk of burns and other internal injuries.

Present exposure standards seek to limit *whole-body* SARs — for instance, the 1982 American National Standards Institute (ANSI) guidelines are keyed to a maximum SAR of 0.4 W/Kg. The ANSI standard also has a clause that specifies a maximum partial-body exposure of 8 W/Kg. The National Institute for Occupational Safety and Health (NIOSH) has recently proposed a similar partial-body limit of 5 W/Kg (see story on p.2). Gandhi has thus measured levels that are nearly 50 times greater than NIOSH's proposed local SAR limit.

Gandhi has also calculated the SARs for children in a radiation field. For a 10-year-old child standing in a 1 mW/cm² field, the maximum local SAR is 371 W/Kg at 50.7 MHz. A 5-year-old child experiences a maximum local SAR of 534 W/Kg at 62.5 MHz.

In a telephone interview, Gandhi said that the fields cause "very large currents" to pass through the human body: "What we thought were very low fields can nevertheless induce currents with very large local SARs." Gandhi, who is with the Department of Electrical Engineering at the University of Utah in Salt Lake City, told *Microwave News* that, "We must understand the role such high currents play in the human body."

According to Gandhi, up to 85 percent of the current passing through the ankles is also flowing through the abdominal region. To put the numbers into perspective, he explained that, *without* cooling by blood flow, an SAR of 70 W/Kg can cause a 1 degree Centigrade rise in body temperature per minute.

Of course, increased blood flow does cool off heated tissue, but whether it can do so before any damage occurs and whether the body's thermoregulatory system can handle the increased heat load are still unresolved questions and in need of study.

Some of Gandhi's data appear in the June issue of the *Proceedings of the IEEE, 73,* 1145-1147. The paper was submitted more than a year ago, and some of the results have now been revised with higher SARs than were originally reported.

(continued on p.9)

HIGHLIGHTS

NIOSH Proposes RF/MW Occupational Standard – Stricter Than ANSI's

The National Institute for Occupational Safety and Health (NIOSH) has proposed worker exposure standards that are, for many frequencies, twice as strict as those set by the American National Standards Institute (ANSI) in 1982. The NIOSH proposal is part of a 293-page draft criteria document on occupational exposures to radiofrequency and microwave (RF/MW) radiation, released at the Bioelectromagnetics Society (BEMS) meeting held in San Francisco, CA, in mid-June.

In the external review draft of the criteria document, NIOSH proposes to limit worker exposures to a maximum of 0.5 mW/cm^2 for the 30-300 MHz frequency range. For 300 kHz-3 MHz, the maximum exposure would be 50 mW/cm^2. Like the ANSI standard, NIOSH proposes adopting a "ramp" type, frequency-dependent standard. Above 3 GHz, the NIOSH proposal would be 5 mW/cm^2, identical to ANSI's. (Excerpts from the NIOSH recommended exposure standard appear on pp.8-9.)

NIOSH is now in the process of soliciting comments on the draft criteria document from experts inside and outside the federal government. A revised draft will then be reviewed by Dr. Donald Millar, director of NIOSH. If approved, the final document should be issued next year.

The completed NIOSH document will be forwarded to the Occupational Safety and Health Administration (OSHA), which could set a standard for workplace exposures — though at present OSHA has no plans to do so (see *MWN*, November 1983 and March 1984).

Such a standard could affect a large number of workers. According to a report prepared for OSHA in 1982 by Centaur Associates, nearly nine million Americans are exposed to non-ionizing radiation on the job.

Basis for the Standard

The NIOSH standard is based on a threshold for adverse bioeffects at a specific absorption rate (SAR) of approximately 2 W/Kg. Using a safety factor of 10, NIOSH recommends that average whole-body SARs be limited to 0.2 W/Kg. In comparison, the ANSI standard is keyed to an average SAR of 0.4 W/Kg.

According to NIOSH, "No measurable core temperature increases are expected to occur in man or animals at SARs of 0.2 W/Kg or less. Few substantiated biological changes of any type have been reported in animals at SARs lower than 0.2 W/Kg, and the changes that occurred were not judged by NIOSH to have any significant effect on the health of the animal. SARs below 0.2 W/Kg are thus not expected to have any significant effect on man....The 0.2 W/Kg limit should prevent any additional increase in body temperature due to RF exposure, regardless of the ambient conditions."

In a paper presented at the BEMS meeting, "Assessment of the Biological Effects of RF Radiation," NIOSH's Dr. Joseph Lary, Dr. David Conover and William Murray summarized the basis for the NIOSH recommendations:

> Several adverse effects have been reported at SARs between 1.8 and 4.5 W/Kg including death (rats and rabbits); rectal temperature increases exceeding 3 degrees C (monkeys, dogs); hemorrhagic lesions, other tissue lesions, and tubular nephrosis (rabbits); staggering, muscular flaccidity and collapse, and spasms of the legs and wings (chicks); and extreme agitation, impaired locomotion, and exhaustion (dogs). At SARs exceeding 4.5 W/Kg, prolonged exposure generally produced severe hyperthermia in most animals and caused a variety of adverse health effects. At SARs below 1.8 W/Kg, no biological effects were reported which were considered by the authors to be clearly adverse to the animals' health. However, in the SAR range of 0.17-1.8 W/Kg, measurable increases in body temperature were reported as well as several distinctive physiological and behavioral changes. At SARs below 0.17 W/Kg, no temperature increases were reported and most of the biological effects involved increases in calcium efflux from the brain or increased permeability of the blood-brain barrier.

With respect to the calcium efflux effect, the NIOSH staffers argued that it "has no known significance to the health of the animal." As to the possibility of microwave-induced leakage through the blood-brain barrier, they concluded that this effect "has been difficult to replicate at low exposure levels and may be an experimental artifact."

The 0.2 W/Kg exposure limit should protect against any "significant interactions between RF radiation and drugs or chemical substances to which the worker might be exposed," according to the draft document. Of special concern, NIOSH cited the finding that RF/MW radiation can enhance the carcinogenicity of benzopyrene in mice at SARs as low as 2.0 W/Kg.

In the criteria document, NIOSH explains the need for the safety factor of ten partly because of uncertainty over heating effects in humans and rhesus monkeys — the agency notes that no significant temperature rise occurs in animals at SARs below 0.17 W/Kg — and partly because theoretical models indicate that the human thermoregulatory system is not affected at levels below 0.2 W/Kg. In addition, NIOSH cites the fact that "little is known about the long-term effects of chronic exposure of workers to RF radiation" and that, "The epidemiology literature presently does not provide an adequate basis to determine the long-term human health effects, if any, from exposure to RF radiation."

Under the NIOSH proposal, average whole-body exposures can exceed 0.2 W/Kg if partial-body exposures are not over 5 W/Kg — averaged over any one gram of tissue. The 1982 ANSI standard has a similar exclusion clause but with a maximum peak SAR of 8 W/Kg.

NIOSH explains: "It thus appears that continuous lo-

calized exposure of even poorly perfused tissues at an SAR of 5 W/Kg will not result in a localized temperature increase of more than a few tenths of a degree Centigrade and will not damage the exposed tissue." This 5 W/Kg limit should protect the lens and the pituitary gland from localized RF power deposition, according to NIOSH.

RF Shocks and Burns

NIOSH is seeking to protect workers against shocks and burns, irrespective of the ambient field:

> Exposure conditions which will cause an involuntary response (startle reaction) due to an RF shock or current flow are not permitted from 300 kHz to 300 GHz. In addition, exposure conditions which will cause an RF burn are not permitted from 300 kHz to 300 GHz. These restrictions apply even if the exposure limits of this standard are not exceeded.

For frequencies below 3 MHz, NIOSH concludes that the 50 mW/cm^2 exposure limit will protect workers against shocks, burns or excessive SARs *if* there is no contact with a conducting object. When such a contact is made, however, the risks are much greater.

For instance, the NIOSH staffers cite estimates that a worker in a 3 MHz electric field at 50 mW/cm^2 who touches a grounded conductive object with his hand could experience an SAR of 16,625 W/Kg, a level which "would obviously cause an RF burn or a possible accident-causing startle reaction."

NIOSH does not propose controlling RF shock and burn risks by limiting ambient field strengths, however. Instead, the agency advocates that such hazards "are best prevented by implementing appropriate safety features on a source-by-source basis rather than by limiting the incident field." The use of insulated gloves, shoes and other protective clothing is suggested as a possible control strategy.

NIOSH's Consultants

In preparing the document, NIOSH staffers consulted the following experts: Dr. Ernest Albert, George Washington University Medical Center, on central nervous system effects; Drs. Virginia Bruce-Wolff and Don Justesen, VA Hospital, Kansas City, on behavioral effects; Dr. Russell Carpenter, Food and Drug Administration, on ocular effects; Dr. Om Gandhi, University of Utah, on dosimetry; Dr. Ronald Jensh, Thomas Jefferson Medical College, on reproductive effects; Dr. Robert Lebovitz, University of Texas Health Science Center, on auditory effects; Dr. Robert Liburdy, U.S. Air Force School of Aerospace Medicine, on hematologic/immunologic effects; Dr. Shin-Tsu Lu, University of Rochester, on cardiovascular effects; Dr. Sol Michaelson, University of Rochester, on pathophysiological effects; and Dr. Vernon Riley, Pacific Northwest Research Foundation, on neuroendocrine effects.

Editor's Note

Microwave News Goes Bimonthly

With this issue, *Microwave News* begins a new publication schedule in a new, expanded format. Each issue will now be 16 pages long, and we will now publish bimonthly, rather than 10 times a year. These two changes, taken together, will result in essentially the same amount of news coverage over the year, while allowing us to cut costs.

We are making these changes to forestall an increase in subscription price. We have not raised our prices for three years and are reluctant to do so now, even though our expenses have gone up substantially.

Microwave News enjoys a very high renewal rate and we thank you for your loyalty. We trust that the changes we are making now will not affect your reliance on the newsletter as the premier source of information in the field. We encourage subscribers who are adversely affected by this change to contact us.

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If you count on us for all the news from the nonionizing radiation community, we urge you to tell your associates how valuable the newsletter is. If we expand our subscription base, we will be able to hold off future price increases.

If you are reading someone else's copy, please get your own. If the newsletter takes a long time to circulate around your office, consider taking out additional subscriptions. If you are reading a photocopy, you are *breaking the law* and you should definitely subscribe.

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The September/October issue of *Microwave News* will be published about three weeks late. We will resume our regular publishing schedule with the November/December issue.

ELF and Cancer: An Update

The number of papers and letters on the suspected link between extremely low frequency (ELF) radiation and cancer continues to grow. Reported below are the latest developments. (See also *MWN*, October 1984 and May 1985.)

Neuroblastoma Risks

Drs. Margaret Spitz and Christine Johnson have found that the children of fathers exposed to electromagnetic fields on the job had a significantly increased risk of developing neuroblastoma, a malignant tumor of the central nervous system (a twofold elevated risk: odds ratio of 2.13). Males who reported themselves to be electronics workers had an even greater risk of fathering children with neuroblastoma — though the number of such cases was small, the odds ratio was 11.75.

The researchers conclude that, while there are "inherent problems" associated with the use of indirect measures of exposure and of occupational groupings, as well as the possible confounding problem of chemicals and heavy metals, "Even a suggestive association [between electromagnetic fields and] childhood cancer is disconcerting, and replication studies in other populations are warranted."

Spitz is at the M.D. Anderson Hospital and Tumor Institute at the University of Texas, and Johnson is at the University of Texas School of Public Health, both in Houston. Their paper, "Neuroblastoma and Paternal Occupation: A Case-Control Analysis," appears in the June 1985 issue of the *American Journal of Epidemiology, 121,* 924-929.

Leukemia in Canada

High voltage power line workers have a threefold increased risk of dying of leukemia, according to Dr. Geoffrey Howe of the National Cancer Institute of Canada in Toronto. This finding emerged from a broader study of cancer mortality in Canada by Howe and Dr. Joan Lindsay, an epidemiologist with Statistics Canada, also in Toronto (see their paper in the *Journal of the National Cancer Institute, 70,* 37-44).

In a telephone interview, Howe told *Microwave News* that while the increased risk to power line workers is statistically significant, the number of cases studied is small. He explained that his research is designed to generate hypotheses rather than to yield conclusions about specific types of occupational risks. He said that, given the observed increased risk to power linemen, "the time has come to do some definitive studies." Howe plans to submit a letter to *Lancet,* the British medical journal, on the power line-leukemia link.

Brain Tumors

In our October 1984 issue, we reported on results obtained by Dr. Ruey Lin and colleagues at the Maryland Department of Health and Mental Hygiene which suggest a link between exposure to electromagnetic fields and the development of brain tumors. Their paper has now been

Symposium on Electropollution and Brain Tumors

Nobel laureate Dr. Marshall Nirenberg will head the list of participants at a symposium on the *Biological Effects of Electropollution: Brain Tumors and Experimental Models* to be held September 9 at Howard University in Washington, DC.

Dr. Sisir Dutta of the university's Departments of Botany and Oncology and Dr. Richard Millis of the Departments of Neurology and Zoology are organizing the university-sponsored meeting.

Other participants include: Dr. Carl Blackman of the Environmental Protection Agency (EPA), Dr. Om Gandhi of the University of Utah, Dr. Eugene Goodman of the University of Wisconsin-Parkside, Dr. B.E. Hackley of the U.S. Army's Institute of Chemical Defense at Edgewood Arsenal in Maryland, Dr. Bruce Kleinstein of Information Ventures, Dr. Ruey Lin of the Maryland Department of Health and Mental Hygiene and Dr. Margaret Spitz of the M.D. Anderson Hospital and Tumor Institute at the University of Texas in Houston.

Dutta and Millis are inviting researchers in the field of radiofrequency and microwave radiation biology who want to participate in the afternoon session to submit a letter of inquiry or an abstract. According to Millis, there are still five open slots for speakers; those selected will receive funds for travel and accommodations.

Nirenberg, the chief of the Biochemical Genetics Laboratory at the National Heart, Lung and Blood Institute in Bethesda, MD, has developed an experimental model for the study of neuroblastoma and will discuss potential applications at the meeting.

Dr. Joe Elder of the EPA will be the luncheon speaker, addressing the public policy issues associated with electropollution.

The symposium is open to the public, but attendance is limited to about 60. Pre-registration is required, but there is no fee. The proceedings of the meeting will be published. The symposium will be held at the Howard University Inn, adjacent to the campus.

For more information, contact Dutta or Millis at Electropollution Symposium, PO Box 83, Howard University Administration Bldg., Washington, DC 20059, (202) 636-6933.

published: "Occupational Exposure to Electromagnetic Fields and the Occurrence of Brain Tumors" appears in the June issue of the *Journal of Occupational Medicine, 27,* 413-419.

In addition to their earlier findings, Lin and coworkers report that "the mean age at death was found to be significantly younger among cases in the presumed high [electromagnetic] exposure group."

Responses to Milham

Dr. Samuel Milham's April 6 letter to *Lancet* claiming support for the hypothesis that electromagnetic fields are carcinogenic (see *MWN,* May 1985) has generated a number of replies, which in turn have prompted comments.

Two letters, published in the May 11 issue of the journal, contend that the "Silent Keys" column in the American Radio Relay League's (ARRL) *QST* magazine, used by Milham as an index of recent deaths, is incomplete and that Milham had failed to control for the hazards of dust and fumes from soldering electronic components.

Harsher criticism came from ARRL's Committee on the Biological Effects of RF Energy, chaired by Raymond Wrangler, in a letter in the June 29 *Lancet.* The committee members argue that Milham's "hypothesis that electromagnetic fields are carcinogenic remains purely speculative" and that, "On the basis of the data we have seen, it cannot be assumed that participation in amateur radio activities increases the risk of leukemia." They are also critical of Milham's use of proportional mortality ratios (PMRs).

Then, in the July 13 issue, Dr. Michael Coleman of the ICRF Cancer Epidemiology and Clinical Trials Unit in Oxford, England, took the ARRL committee to task for its "inaccurate commentary" on Milham's original letter, including the discussion of PMRs. Coleman also explained that, even if the "Silent Keys" column omitted some cases, the impact on Milham's analysis would be minimal: "Milham's result could be wrong — but it is unlikely to be far wrong. Any bias toward preferential reporting of leukemia deaths...would have to be severe; Milham would need to have missed over 1,500 deaths, not one of them due to leukemia, for his result to be entirely due to such a bias."

In 1983, Coleman reported that he and coworker Janine Bell had found a statistically suggestive link between ELF and leukemia in a population of electrical workers in southeast England (see *MWN,* June 1983).

Epidemiology Handbook

Drs. Tim Aldrich and Clay Easterly of Oak Ridge National Laboratory have assembled a *Handbook of Epidemiologic Methods with Special Emphasis on ELF Fields,* a guide to the literature on ELF effects, focusing primarily on the possible link to cancer. Copies will be available soon at no cost. Write to the authors at the Health and Safety Research Division, Oak Ridge National Lab, Oak Ridge, TN 37831. Include a self-addressed mailing label.

Portland, Oregon Proposes 100 uW/cm² Standard – Again

The City of Portland's Bureau of Planning has reaffirmed its support for a general population exposure standard of 100 uW/cm² for 30-300 MHz radiation. A new proposal by the bureau calls for regulation of the siting and operation of all television and radio stations in Portland, the largest city in Oregon.

The new initiative, issued in July, is intended to clarify the existing regulatory framework, which the city planners found to be inconsistent and, sometimes, inequitable. If approved by the City Planning Commission and the City Council, the plan will require operators of all existing radio and television broadcasting facilities in the frequency band between 100 kHz and 300 GHz to register with the city. Those seeking to build new broadcasting stations will have to apply to the city and conduct radiation measurements around the proposed sites.

The Planning Commission held hearings on the bureau's proposal on July 23 and is expected to reach a decision by September. The City Council will not take final action before December.

Over the 100 kHz to 300 GHz range, the proposed Portland standard is ten times stricter than the 1982 American National Standards Institute (ANSI) standard. The planning bureau concluded that the ANSI limit "does not allow a sufficient margin of safety from known adverse impacts on living tissues."

Portland adopted a 100 uW/cm² interim standard in 1980 — the first public exposure standard in the United States. Although the rules were approved by the Planning Commission, they were never incorporated into the city's zoning rules by the City Council.

In September 1984, the City Council passed an ordinance placing a moratorium on new permits for radio and television facilities until July 1, 1985. In June, the council extended the moratorium until completion of its regulatory review or until January 1, 1986, whichever comes first. According to Steven Gerber, the principal author of the proposed regulations, the moratorium only applies to "major" sources — those with an effective radiated power of 500 or more watts. Thus point-to-point and mobile communications systems are exempt.

The planning bureau contends that its new recommendations "are intended to provide a consistent and knowable set of criteria for the operation and siting of RF broadcast facilities, while providing protection to the general population from RF emissions and the aesthetic impacts of significant broadcast facilities."

The situation in Portland is complicated by the fact that Multnomah County, in which Portland is situated, has its own radiofrequency and microwave radiation standard — 200 uW/cm² in the 30-300 MHz band. Originally, the county had proposed a 50 uW/cm² standard, but backed off in the face of opposition from local broadcasters (see *MWN,* July/August 1982). The city's new proposal is very similar to the county rules, but the exposure levels are

twice as strict. According to the bureau's report, the Portland measure "has been written specifically to be compatible with the Multnomah County regulations."

The Portland planners argue that their proposal will not have any adverse economic impacts. They state that "There is no evidence that the admittedly conservative 100 uW/cm^2 standard will cause any significant hardship on the broadcast industry here in Portland." In addition, they have found no firm evidence "to suggest a negative impact on property values from proximity to broadcast facilities."

The Bureau of Planning has issued a three-volume report, *Radiofrequency (RF) Regulatory Review Project*, consisting of a "Report and Recommendations to the Planning Commission," a "Background Document" and a "Technical Appendix."

In the process of preparing the report, the bureau set up an RF Task Force, consisting of citizens, industry representatives and medical and technical experts.

For more information, contact Steven Gerber, Bureau of Planning, City of Portland, Room 1058, 1120 SW Fifth Ave., Portland, OR 97204, (503) 796-7706.

Hawaii Broadcasts Blamed for Burns and Extensive EMI

Radiation from broadcast antennas in Honolulu, Hawaii, is being blamed for shocks, burns and numerous instances of electromagnetic interference (EMI) with electronic equipment in high-rise condominiums neighboring the radio tower.

A study commissioned by Honolulu Councilmember Marilyn Bornhorst and released in June found that AM radio (550 kHz-1.6 MHz) broadcasts are a potential source of injury and are disrupting telephone answering machines and radio and television reception.

Richard Melton, a consultant who surveyed the residents of three condominiums for Bornhorst, concluded that metal objects in the apartments pose a danger of shocks and burns, ranging from "mild to capable of causing injury." He warned that "The severity of some of these problems is alarming and indicates a continuing danger of injury."

In the report, Melton characterized the interference as a "significant nuisance to many residents" at the two buildings closest to the transmitters — 100-250 feet from Ala Wai tower, from which 3 AM stations broadcast. At the third building, which is about 350 feet from the tower, reports of EMI-type disturbances were less common. The survey also included a fourth building more than a mile from the tower to serve as a control.

Other types of interference included buzzing in the ears and music emanating from interior walls, air conditioners and gold teeth. Also, radio broadcasts were recorded onto tape and video recorders and telephone answering machines.

The May 27 *Honolulu Advertiser* reported that one resident of the Villa on Eaton Square, one of the buildings surveyed, had gone through four answering machines in the hope of finding one that does not pick up spurious radio signals. On occasion, she returned home to find that, instead of her phone messages, she had a one-hour tape of rock music. She also experienced EMI problems with her stereo, television and electronic organ.

Zoning Changes Recommended

Melton argued that "The survey results leave little doubt that the phenomena being reported are caused by radiofrequency radiation and give sufficient information to initiate changes in land use policies regarding broadcast towers."

Melton recommended that federal standards be set for siting radio and television transmitters to reduce both potential health risks and EMI and called for a retrospective health study of "as many persons as possible who have lived and/or worked for significant periods of time near sources of radiofrequency radiation." He also urged local, state and federal officials to form a task force "to work out a consensus solution to the existing radiofrequency radiation problems."

In releasing the survey results in early June, Bornhorst supported the report's recommendations. She said that the data provide "sufficient evidence" that Honolulu's zoning code should be changed to distance broadcast towers from areas where people live and work. Zoning rules currently prohibit siting transmitter towers on the hills surrounding the city, forcing broadcasters to place them in the city.

EPA-FCC Survey

In May 1984, Richard Tell of the Environmental Protection Agency (EPA) and Dr. Robert Cleveland of the Federal Communications Commission (FCC) measured levels as high as 306 mW/cm^2 next to the access-limiting fence at the Ala Wai tower. In a recreational area on the roof of the Villa on Eaton Square, they found AM levels greater than 24 mW/cm^2 (see *MWN*, January/February 1985).

In a press release accompanying Melton's report, Councilmember Bornhorst expressed alarm that the EPA-FCC measurements contrasted sharply with the agencies' press statements that residents near the tower are in no immediate danger. "How can they say that when they knew about the danger of burns, they know that there is an epidemic of birth defects in Vernon Township (another 'hot spot'), and they know of long-term studies that show it causes cancer in laboratory animals," she said.

For a copy of the report, *Survey of Phenomena Experienced by Residents Living Close to the Ala Wai Broadcasting Tower, Honolulu, Hawaii* (June 1985), contact: Councilmember Marilyn Bornhorst, City Council, Honolulu, HI 96813, (808) 523-4000.

Florida Panel Discounts Power Line Bioeffects

The Florida Electric and Magnetic Fields Science Advisory Commission (SAC) has concluded that "It is unlikely that human exposure to 60 Hz electric and magnetic fields can lead to public health problems." The one-year,

$200,000 study was funded by the Florida Electric Power Coordinating Group (FCG), a consortium of state electric utilities, for the Florida Department of Environmental Regulation (DER).

The only adverse environmental effects associated with 230-or-greater kV transmission lines are the potential for pacemaker interference and shocks to honeybees living in hives under the lines, according to the SAC report.

The panel noted that "Adverse public health effects of such fields have not yet been established," but that "Because of certain ambiguities in the currently available scientific information, further developments in the area should be monitored." However, the panel added: "Once an initial decision has been made in Florida that public health problems are unlikely, reopening the area for further consideration would not be justified unless a significant new body of experimental evidence becomes available."

The SAC also concluded that "there is not currently sufficient evidence to allow the scientifically based choice of a measure of exposure to electric and magnetic fields that could be used as the basis for a program of exposure control."

The 266-page report, *Biological Effects of 60-Hz Power Transmission Lines*, recommends that "Concerned parties ...should urge the Food and Drug Administration to revise pacemaker testing and performance criteria so as to include circumstances representative of transmission line induced currents and appliance leakage currents."

The panel called on state agencies and the electric utilities to inform beekeepers of potential risks to their bees and of ways to eliminate these risks — grounded chicken wire surrounding the hives is sufficient in most cases.

The SAC was formed by the FCG as an independent source of scientific expertise to the DER. The department had been charged with responsibility for assessing potential health hazards of transmission lines and, if necessary, for promulgating safety regulations, as a result of legislation passed in 1983 following siting disputes (see *MWN*, July/August 1983 and July/August 1984). Despite its apparent link to the utilities, the commission's report explains that the panel operated at "arm's length" from the utilities and that the DER is not bound by the SAC's recommendations.

The commission was chaired by Professor H.B. Graves of the Pennsylvania State University in University Park, who also chaired a study on the Navy's Project ELF, which similarly concluded that the ELF fields would be "unlikely" to pose a health or environmental problem (see *MWN*, May 1985).

Other SAC members were: Dr. T. Dan Bracken of Scientific Research and Consulting Services in Portland, OR; Dr. Jerry Griffin of the University of California in San Francisco, CA; Dr. John de Lorge of the Naval Aerospace Medical Research Lab in Pensacola, FL; Dr. M. Granger Morgan of Carnegie-Mellon University in Pittsburgh, PA; and Dr. Tom Tenforde of the Lawrence Berkeley Laboratory in Berkeley, CA.

For more information, contact the FCG's Ron Spika, 402 Reo St., Suite 214, Tampa, FL 33609, (813) 877-5301. The report is available from the National Technical Information Service (NTIS), Springfield, VA 22161, (703) 487-4650.

CONFERENCES

September 9: **Biological Effects of Electropollution: Brain Tumors and Experimental Models,** Howard University Inn, Washington, DC. Contact: Electropollution Symposium, PO Box 83, Howard University Administration Bldg., Washington, DC 20059, (202) 636-6933.

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

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

September 12-14: **1st Annual Clinical Hyperthermia Symposium and Workshop,** St. Louis, MO. Contact: Dr. B. Emami, Division of Radiation Oncology, Mallinckrodt Institute of Radiology, 4511 Forest Park Blvd., Suite 311, St. Louis, MO 63108, (314) 362-3470.

September 23-26: **4th International Conference on AC & DC Power Transmission,** London, UK. Contact: Institution of Electrical Engineers (IEE), Savoy Place, London WC2R 0BL, UK, (01) 240-1871.

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

October 3-5: **2nd Congress of the European Society of Magnetic Resonance in Medicine and Biology,** Montreux, Switzerland. Contact: Dr. M.A. Hopf, 1 route de Florissant, CH-1206 Geneva, Switzerland, (41)(22) 472547.

October 7-9: **1985 International Geoscience and Remote Sensing Symposium,** University of Massachusetts, Amherst. Contact: Professor Calvin Swift, Dept. of Electrical and Computer Engineering, University of Massachusetts, Amherst, MA 01003.

October 13-17: **5th International Meeting of the Bioelectrical Repair and Growth Society,** Park Plaza Hotel, Boston, MA. Contact: Dr. S.R. Pollack, University of Pennsylvania, 119 Towne Bldg., 220 South 33rd St., Philadelphia, PA 19104, (215) 898-8241.

October 15-18: **Phased Arrays 85,** Bedford, MA. Contact: Dr. Hans Steyskal, RADC/EEA, Hanscom AFB, MA 01731, (617) 861-2052.

October 21-24: **1985 Conference on Electrical Insulation and Dielectric Phenomena,** Marriott Hotel, Amherst, NY. Contact: Steven Boggs, Ontario Hydro, 800 Kipling Ave., Toronto, Ontario M8Z 5S4, Canada, (416) 231-4111, ext. 6735.

November 5-6: **1985 Producibility of Microwave and Millimeter Integrated Circuits Conference,** Redstone Arsenal, AL. Contact: Joe Derie, U.S. Army Missile Command, Attn.: AMSMI-EE, Redstone Arsenal, AL 35898, (205) 876-8421.

November 5-7: **Review of Contractors Research on the Biological Effects of Electric and Magnetic Fields Associated with High Voltage Transmission Lines,** Radisson Mark Plaza Hotel, Alexandria, VA. Contact: Dr. William Wisecup, Aerospace Corp., Suite 4000, 955 L'Enfant Plaza, SW, Washington, DC 20024, (202) 488-6328.

EXCERPTS

NIOSH Draft Occupational RF/MW Exposure Standard

Reprinted below are excerpts from the occupational radiofrequency and microwave (RF/MW) radiation exposure standard proposed by the National Institute for Occupational Safety and Health (NIOSH) in the external review draft of its criteria document. The draft document was released at the annual meeting of the Bioelectromagnetics Society in San Francisco, CA, in June. *See story on pp.2-3.*

Explanations and Limitations of REL Usage

The explanations and limitations of recommended exposure limit (REL) usage are an integral part of the recommended Occupational Exposure Standard. It is essential to understand these explanations and limitations prior to determining compliance with this standard.

1. The RELs apply to both partial and whole-body exposures unless the provisions given in the section on "Exclusions from REL Usage" can be met.

2. All mean squared electric field strength (E^2), mean squared magnetic field strength (H^2) and equivalent plane-wave power density values shall be determined by free-space measurements (i.e., under exposure conditions in which *no part of the worker* is in contact with an electrically conductive surface whether or not the surface is grounded).

3. From 300 kHz to 300 MHz, measurement of both mean squared electric field strength (E^2) and mean squared magnetic field strength (H^2) is required for compliance. Measurement of equivalent plane-wave power density is not permitted for compliance at frequencies from 300 kHz to 300 MHz.

4. Above 300 MHz, measurement of either mean squared electric field strength (E^2), mean squared magnetic field strength (H^2), or equivalent plane-wave power density is sufficient for compliance.

5. RELs apply to both pulsed wave (PW) and continuous wave (CW) RF radiation exposures. For pulsed RF radiation sources, the average of the mean squared electric field strength, mean squared magnetic field strength or equivalent plane-wave power density is calculated by multiplying the peak pulse value of the mean squared field strength or power density by the duty cycle. The duty cycle is equal to the pulse duration in seconds multiplied by the pulse repetition rate in cycles per second.

6. All mean squared field strength and equivalent plane-wave power density measurements can be time averaged over any 6-minute period for comparison with RELs. This provision applies to CW exposures and to the average of the mean squared field strength and power density values for PW exposures.

7. For mixed or broadband fields consisting of several frequencies for which there are different REL values, the fraction of the REL incurred within each frequency range shall be determined, and the sum of all such fractions shall not exceed unity.

8. Measurements to determine compliance with the standard shall be made at distances of 5 cm or greater from any object.

9. This standard is not intended to apply to the purposeful exposure of patients by or under the direction of practitioners of the healing arts.

10. Exposure conditions which will cause an involuntary response (startle reaction) due to an RF shock or current flow are not permitted from 300 kHz to 300 GHz. In addition, exposure conditions which will cause an RF burn are not permitted from 300 kHz to 300 GHz. These restrictions apply even if the exposure limits of this standard are not exceeded. Shock and burn hazards can be controlled through the use of insulated gloves, shoes and other protective clothing; by insulating the RF source and conducting objects within the RF field; by using proper grounding techniques; or by eliminating the possibility of worker contact with the source or with conducting objects in the field. Extra precautions should be taken around long conductive objects such as wires, cables and cranes and around large ungrounded objects such as cars, trucks and buses when these objects are in close

NIOSH Draft RF/MW Exposure Limits

Frequency Range	Equivalent Plane-Wave Power Density (mW/cm^2)	Mean Squared Electric Field Strength (V^2/m^2)	Mean Squared Magnetic Field Strength (A^2/m^2)
0.3-3 MHz	50	188,500	1.33
3-30 MHz	$450/f^2$	$3{,}770(450/f^2)$	$0.027(450/f^2)$
30-300 MHz	0.5	1,885	0.013
300 MHz-3GHz	f/600	3,770(f/600)	0.027(f/600)
3 GHz-300 GHz	5	18,850	0.133

Note: f = frequency in MHz.

proximity to high power RF sources such as AM and FM broadcast antennas. The proper control measures for a particular exposure condition vary. Each case must be carefully analyzed to determine the optimum method of preventing RF shocks or burns.

11. These RELs and associated explanations, limitations and exclusions apply under all environmental conditions regardless of ambient air temperature, relative humidity, air velocity or the radiant energy input at frequencies higher than the frequency range of this recommended standard.

Exclusions from REL Usage

These exclusions from REL usage are an integral part of the recommended standard. It is essential to understand and correctly apply this information when claiming exclusions from REL usage during compliance determinations.

1. For frequencies from 300 kHz to 30 MHz, the RELs may be exceeded if it can be demonstrated that the average whole-body SAR does not exceed 0.2 W/Kg, that the spatial peak SAR does not exceed 5 W/Kg as averaged over any one gram of tissue and that RF burns and startle reactions do not occur. However, exposures greater than 50 mW/cm^2 (188,500 V^2/m^2, 1.33 A^2/m^2) will not be permitted for continuous exposures longer than 6 minutes, even if the above conditions are met.

2. For frequencies above 30 MHz, the RELs may be exceeded if it can be demonstrated that the average whole-body SAR does not exceed 0.2 W/Kg, that the spatial peak SAR does not exceed 5 W/Kg as averaged over any one gram of tissue and that RF burns and startle reactions do not occur.

VLF and RF Radiation Risks *(continued from p.1)*

Burns and Shocks

In a paper presented at the *7th Annual Meeting of the Bioelectromagnetics Society (BEMS)* held in San Francisco, CA, June 16-20, Gandhi reported that "the currents flowing through the hand of a human in conductive contact with the handle of an ungrounded van can be as high as 879 mA and produce a local SAR in the wrist of about 1045 W/Kg." This experiment was run at 3 MHz at 100 mW/cm^2.

With respect to ways of protecting workers in such electrical environments, Gandhi reported that "electrical safety shoes and gloves provide adequate protection from induced currents up to about 1 MHz."

The Utah research is an extension of ongoing work on VLF radiation hazards funded by the U.S. Air Force School of Aerospace Medicine at Brooks Air Force Base in San Antonio (see *MWN,* May and September 1983). In an earlier paper, Gandhi reported that the electric fields associated with 100 mW/cm^2 300 kHz-3 MHz fields — exposure levels allowed under the 1982 ANSI guidelines — could cause RF burns (see *Proceedings of the IEEE, 70,* 1462-1464, December 1982).

Gandhi's VLF results have been generally confirmed by Professor Bill Guy at the University of Washington in Seattle, whose work was also funded by the Air Force. Both Gandhi and Guy have found that VLF radiation can cause hot spots in the wrist.

According to William Hurt, the Air Force project officer for both studies, final reports on the studies should be available soon.

ANSI Standard Will Need Revision

In his talk at the BEMS meeting, Gandhi said that the 1982 ANSI guidelines are "clearly too high for the general population."

Similarly, in reviewing his VLF findings, Guy told the audience that the new results will require a change in the ANSI standard.

The new hot spot and body current data are likely to add fuel to the ongoing debate on the safety of human exposure to radiation from radio, television and high frequency transmitters (see *MWN,* May 1985). In Honolulu, HI, for example, measurements by the Environmental Protection Agency and the Federal Communications Commission found AM radiation (550 kHz-1.6 MHz) levels as high as 3,054 mW/cm^2 (see story p.6). Gandhi's data could also have an impact in the 54-88 MHz band, used for television broadcasting.

The findings could also increase awareness of the health risks to those who use RF energy in industry. Of special concern are workers who use RF heaters and sealers, which operate in the 3-100 MHz frequency band.

While many of the BEMS attendees agreed with the Gandhi and Guy opinions that the ANSI standard needs immediate review in light of the new data, Subcommittee IV on "Safety Levels and/or Tolerances with Respect to Personnel" of the Accredited Standards Committee C95 will not begin considering any changes until next June.

Although the C95.1 standard will continue to be an official ANSI standard, the committee will no longer be an ANSI committee; instead it will be called the Accredited Standards Committee C95. The committee will continue to be sponsored by the IEEE and the U.S. Navy.

At a meeting on June 20 immediately following the BEMS conference, Dr. Kristian Storm of the UCLA School of Medicine, chairman of the C95.IV subcommittee, said that he was aware of the new Gandhi and Guy data and that they are being studied. According to Storm, budgetary and time constraints prevent a meeting before next year, when he plans to hold a two-day session to frame a proposed revision to the 1982 standard. That meeting is tentatively scheduled to coincide with the 1986 BEMS meeting, which will be held June 1-6 at the University of Wisconsin in Madison.

The C95.IV subcommittee meeting was held in the late afternoon after the close of the BEMS meeting, when many of the participants were making their way home. Neither Gandhi nor Guy was able to attend. ●

UPDATES

BIOLOGICAL EFFECTS

Immunology in the U.S.S.R....A group of researchers at the Kiev Institute for General and Communal Hygiene report that low-level exposure to 2375 MHz microwaves first stimulates and then depresses the immune system. Rats exposed to power densities of 10-50 uW/cm^2 experience a "strain on the energy metabolism processes occurring in neutrophils over the course of three weeks of irradiation." (Neutrophils are leukocytes.) A translation of "Immunological and Hematological Effects of Low Intensity SHF-Band Electromagnetic Fields" by G.I. Vinogradov and coworkers appears in *Biological Effects of Non-Ionizing Electromagnetic Radiation* (Vol.8, No.3, June 1984). See below.

Bibliographies... The Office of Naval Research has released three new volumes in its series, *Biological Effects of Non-Ionizing Electromagnetic Radiation:* Vol.8, No.3 (June 1984), Vol.8, No.4 (September 1984) and Vol.9, No.1 (December 1984). The last volume contains a complete translation of the abstracts of the papers presented at the *All-Union Symposium on the Biological Effects of Electromagnetic Fields,* held in Pushchino, U.S.S.R. in 1982. A limited number of copies of each volume are available from the Office of Naval Research, Code 441, Arlington, VA 22217 (include a mailing label)....The U.S. Air Force has released the fifth volume in its continuing collection of the RF/MW literature, *USAFSAM Review and Analysis of Radiofrequency Radiation Bioeffects Literature* (USAFSAM-TR-85-7). This edition contains a critical look at 40 papers and a cumulative index of the 200 papers reviewed in the 5 volumes issued to date. The reviews were written by Louis Heynick and Dr. Peter Polson of SRI International in Menlo Park, CA. Copies are available from the National Technical Information Service (NTIS), Springfield, VA 22161.

Honeybees and Power Lines... Honeybee colonies near power lines can suffer adverse effects, according to an EPRI study conducted by Bernard Greenberg and Vytas Bindokas, of Bioconcern and the University of Illinois at Chicago, and James R. Gauger, of the IIT Research Institute, also in Chicago. Hives were placed at varying distances from a 765-kV line so that they were exposed to electric fields ranging from 0.65 to 7 kV/m; half of the hives were shielded to provide controls. At 4.1 kV/m, the researchers found reduced hive weight and lower propolization (deposit of resinous material collected from tree buds), and at 5.5 kV/m, they noted loss of queens and impaired foraging, indications of serious damage to a colony. At 7 kV/m, fields inside the hive reached 100 kV/m, and shock currents were as high as 500 nA. At the DOE-EPRI-NY State contractors' meeting held in St. Louis on November 7, 1984, the researchers indicated that their data "suggest that colony disturbance under a 765-kV transmission line is not a direct E-field effect, but rather the result of shocks from induced-hive or bee-body currents." A forthcoming report will describe the results of a full-scale study that exposed hives and matched controls to field or shock currents independently. The report, "The Effects of High-Voltage Transmission Lines on Honeybees" (EPRI EA-3898, Interim Report), was published in May 1985 and is available for $11.50 (prepaid) from Research Reports Center, PO Box 50490, Palo Alto, CA 94303, (415) 965-4081. (See also their earlier report, EPRI EA-1809, with the same title, dated April 1981 and pp.6-7.)

Manipulating Genes with Electricity... High voltage electrical pulses can induce the introduction of foreign DNA into plant cells — a finding that could play an important role in the genetic engineering of plants. William Langridge, of the Boyce Thompson Institute for Plant Research in Ithaca, New York, and Bao-Jian Li, of the Cunshang University in China, applied short pulses of 40-volt DC to a mixture of bacterial plasmid (extrachromosomal DNA rings) and enzyme-treated carrot cells. About 2 percent of the carrot cells took up and expressed the bacteria DNA, a number 20,000 times greater than would occur without using the technique, called electroporation. The pulses open up the carrot cell membrane, allowing the entry of the foreign DNA. Current methods for introducing foreign DNA into plant cells are difficult and limited. Electroporation may one day allow any gene to be directly introduced into plant cells. See "Zapping DNA Into Plant Cells" in the July 13 *Science News*.

COMMUNICATIONS

An Alternative to Satellites... Soviet researchers are experimenting with powerful electromagnetic pulses to create plasma clouds of charged particles in the ionosphere to reflect TV and radio signals. This technique could possibly lead to an alternative to satellites, according to a December 20, 1984 report from TASS, picked up by the *Review of International Broadcasting* (Issue No. 100, released in June). With careful aiming, the reflected signals can be directed to specific spots on the Earth's surface. The U.S. is also involved in research of this type, though much of it is classified because of its potential application to military communications. For a review of some of the ongoing research, see the collection of papers on "Ionospheric Effects on Radio Systems" in the May-June 1985 issue of *Radio Science,* Vol.20, No.3.

Cellular Phones: Promise v. Reality... Over the last few years, the public has been promised a revolution in mobile communications with the introduction of cellular telephones — already available in 60 U.S. cities, with more to come. It turns out that the promise was greater than the reality. A series of press reports at the end of June noted that the demand for cellular phones is softer than expected and the cost of providing service is more than $2,500 per subscriber. In addition to the marketing problems, the technology may not be working up to expectations. The system was originally hailed as an ingenious way of maximizing the efficient use of the frequency spectrum by dividing a region into hexagonal cells so that the same frequency could be re-used in non-adjoining cells, with a computer automatically transferring a call from one fre-

quency to another as a driver moved around the city. Before the introduction of cellular systems, a city had a maximum of 44 channels; New York City, a prime market, could only handle 12 mobile telephones at once. When the FCC authorized cellular service, they increased the number of channels to 666, allowing many more simultaneous calls. But the promise of adding capacity by splitting cells to accommodate demand is proving to be illusory. Indeed the present capacity is due only to the new FCC allocation, not to the new technology, and the cellular phone companies are in the process of going back to the FCC to ask for more spectrum space. As Andrew Pollack reported in the June 20 *New York Times*, "As the cells get smaller and closer together, coordination among different cells becomes more complex and interference more troublesome....What was pictured in theory as a nice honeycomb pattern of hexagonal cells is turning out to be more of a haphazard jumble of amoeba-shaped cells. As the pattern deviates from the optimal, overall system capacity and quality of service degrade as well." One problem is the resistance of local residents to the siting of antennas in urban areas.

COMPATIBILITY & INTERFERENCE

Woodpecker Watch... Shortwave listeners in North America have organized "The Woodpecker Project" in an effort to force the Soviet Union to control interference caused by its over-the-horizon (OTH) radar system. Coordinated by the Association of North American Radio Clubs' (ANARC) OTH Committee, the Woodpecker Project plans to ask representatives at the 1987 World Administrative Radio Conference (WARC) for High-Frequency Broadcasting to object formally to the Soviet OTH interference, which produces a "pecking" sound. To support this position, organizers of the project are recruiting volunteers to help monitor shortwave frequencies from 5-23 MHz for Woodpecker interference 24 hours a day for a total of 5 days in October; each volunteer will be asked to monitor a 3 MHz band for 3 hours. The Soviet OTH radar uses a 3 to 4 millisecond square-wave pulse with a repetition rate of 10 pulses per second, according to the project, which recently noted that the radar has been operating around 10.7 MHz. For more information, contact Robert Horvitz c/o Woodpecker Project, 1634 15th St., NW, Washington, DC 20009.

Aircraft Generated EMI...NASA is about to undertake a research program to understand and control EMI aboard aircraft. The agency is soliciting bids for the collection of data on conducted and radiated interference to digital circuits — with special attention to fast rise-time transients. One of the goals of this effort is to update existing FAA rules for the safe and compatible use of modern electronic technology. NASA had been negotiating with Chris Kendall Consultants of Mariposa, CA, on a sole-source basis, but opened up the bidding when other parties expressed an interest in the project. The closing date for responses to Solicitation No. RFP2-31865(JAC) is August 8. For more information, contact NASA's Joanne Comstock, NASA Ames Research Center, Moffett Field, CA 94035, (415) 694-5786.

EMI Survey... Frost & Sullivan, an international market research firm, is preparing a study for fall release on the U.S. market for EMI and RFI test equipment. As part of the project, the company has distributed a four-page survey questionnaire to specialists in the field. For more information, contact Raymond Cappiello, Project Director, 73 Hudson Rd., Bellerose Village, NY 11001, (516) 437-4335.

GOVERNMENT

Radiation Research Proposals... Bills have been introduced in both houses of Congress that would shift the responsibility for research on *ionizing* radiation bioeffects from the Department of Energy (DOE) to the Department of Health and Human Services (HHS). The "Radiation Research Reorganization Act" (H.R.1287), introduced by Representative Tim Wirth (D-CO) on February 26, and the "Radiation Reorganization Act" (S.525), introduced by Senator John Glenn (D-OH) on February 27, are virtually identical. Because the DOE is presently charged with the potentially conflicting roles of studying the health effects of radiation and producing and using nuclear materials, some members of Congress have raised questions about the objectivity of its bioeffects research efforts. Although the two bills apply specifically to ionizing radiation, they could open the door to a similar change for ELF (power line) radiation research, presently administered by the DOE's Electric Energy Systems Division. H.R.1287 was referred to both the House Energy and Commerce Committee's subcommittee on health and environment and the House Science and Technology Committee's subcommittee on science research and technology. Glenn's S.525 was referred to the Senate Committee on Government Affairs' subcommittee on nuclear proliferation and government processes. Glenn introduced a similar bill in 1982, S.2284, which would have set up two interagency panels to coordinate research and regulations for ionizing and non-ionizing radiation (see *MWN*, May and June 1982). That bill died in committee.

Cable Leakage Rules Reaffirmed... The FCC has reaffirmed, with minor modifications, its revised Part 76 rules for protecting aeronautical navigation and communications radio services from cable TV leakage interference. The commission argued that "reduced signal leakage is the

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only long-term solution to the problem of interference." In a June 21 "Memorandum Opinion and Order" (50 *Federal Register* 29394, July 19), the FCC denied seven petitions for reconsideration of its rules, which were issued last November (see *MWN*, December 1984), but approved a request to delay for 5 years the mandatory use of a signal-leakage criteria test (the "Cumulative Leakage Index") by cable operators. Other revisions include: (1) the adoption of a 100 microwatt "universal trigger level for FCC notification" for new aeronautical frequencies; and (2) the determination of this threshold level will now use *average* power across a 25 kHz bandwidth in any 160 usec period, rather than *peak* power, as originally required. This latter change was requested by the National Cable Television Association. For more information, contact the FCC's Freda Lippert Thyden at (202) 632-7792 for legal concerns and the FCC's Bernard Gorden at (202) 632-9660 for technical matters.

FCC Enforcement Actions...FCC officials interrupted the start of a corporate liquidation auction because computers that did not meet the commission's RF emissions rules were among the items up for grabs, according to *The Washington Post* (July 25). Seequa Computer Corp., based in Odenton, MD, sold inadequately shielded computers as long ago as last October, a commission spokesman told the newspaper. After some discussion between company and federal representatives, the auction began and the computers were sold — although the purchasers will have to wait at least 4-6 weeks for the FCC to complete lab tests on the units....The FCC has fined three cordless phone manufacturers $2,000 each for selling cordless phones that exceed the commission's standards for radiated power emissions. Under a new sampling procedure that uses commercially available phones rather than prototypes (see *MWN*, November 1984), FCC staffers measured field strengths up to five times as high as the commission's maximum permissible limit of 10,000 uV/m at 3 meters. Matsushita Technology, Pacific Electronics Programs and Webcor Electronics were fined after failing to correct the violations despite warnings from the commission. The FCC fined three distributors of cordless phones for similar violations last January (see *MWN*, January/February 1985)....In another action, the commission has decided to require cordless phone manufacturers to label their products with warnings about the potential problems of RFI and inadequate security — including the use of one's phone by an outside party and inadvertent interaction with other nearby cordless phones. Beginning on November 1, manufacturers will have to describe their phones' security features to purchasers (50 *Federal Register* 24512, June 11). The FCC noted that the Association of Public-Safety Communications Officers (APCO) has been plagued with "drop off" calls to 911 emergency systems — no one is on the line when the call is answered. APCO has traced many of these calls to cordless phones. The FCC has taken no action on this interference problem but promises to reconsider the problem if it persists.

CDRH Reporting Review... The FDA's Center for Devices and Radiological Health (CDRH) has issued a public review draft of its "Report of the CDRH Task Force for Retrospective Review of the Recordkeeping and Reporting Requirements of 21 CFR 1002" (50 *Federal Register* 27024). The task force, set up in 1982 in response to a congressional directive requiring regulatory flexibility (see *MWN*, December 1982), recommends that manufacturers of radiation-emitting products be permitted to file less documentation than now required to prove that they are complying with CDRH regulations. In addition, the task force suggests, the types of reports required should be modified and streamlined. Comments on the recommendations are due by August 30. For more information, contact Melvyn Altman, CDRH (HFX-83), FDA, 5600 Fishers Lane, Rockville, MD 20857, (301) 443-3426.

LITIGATION

Yannon Hearing... Mrs. Antoinette Yannon's $3.5 million product liability suit against RCA for the wrongful death of her husband, Samuel Yannon, due to long-term exposure to microwave radiation, is going back to court. A hearing will be held on September 10 in the state Supreme Court in Staten Island, NY. In July 1982, a Supreme Court judge dismissed the case, but the decision was reversed on appeal (see *MWN*, June 1984). Guy Lawrence of the New York City law firm of Bower & Gardner, which is representing RCA, refused to comment on any aspect of the case. A spokesman for RCA confirmed the September 10 hearing date. Yannon worked on microwave relay equipment at the Empire State Building for 15 years. He retired from New York Telephone in 1971 and died in 1974.

Loesch Dies... Andrew Loesch, a former FAA radar technician who filed a $1.5 million suit against the FAA, claiming he developed a brain tumor from exposure to microwave radiation, died on July 23 (see *MWN*, May 1985). His attorney, Michael Allison of DeLayo and Olson in Albuquerque, NM, told *Microwave News* that the FAA denied the Loesch claim on July 19 and that a workers' compensation claim will be filed on behalf of Loesch's widow, Katherine. Allison said that he is still evaluating whether to file a suit against the manufacturers of the radiation-emitting equipment.

MEASUREMENT

NBS Report... Three members of NBS's Electromagnetic Fields Division have prepared a report, *Possible Estimation Methodologies for Electromagnetic Field Distributions in Complex Environments (Technical Note 1081)*, which outlines three ways of approximating field strengths when there are multiple sources operating at different frequencies. M. Kanda, J. Randa and N.S. Nahman outline the approaches: a statistical treatment, a numerical computation and the use of a directional probe. While the methods are still under development, the researchers expect them to help in the prediction of maximum field strengths inside buildings housing sensitive electronic and ordinance equipment and thereby prevent interference problems. The

report is available for $2.00 from the Government Printing Office, Washington, DC 20402. Order No. 003-003-02638-7.

MEDICAL APPLICATIONS

Diathermy and Low Back Pain...A placebo treatment for low back pain proved to be as effective as short-wave diathermy (SWD) or osteopathy in a study by researchers at Guy's Hospital in London. T. Gibson and coworkers at the Department of Rheumatology randomly divided 109 patients who had suffered low back pain for 2-12 months into 3 groups: one was treated with SWD, a popular therapy for low back pain, another was treated by an osteopath (chiropractor) and the third was treated with an unplugged SWD unit that appeared to be functioning. 8 weeks after 4 weeks of treatment (3 times weekly with the active or inactive SWD, once weekly by the osteopath), 59 percent of those treated with SWD reported improvement, as did 62 percent of those treated with osteopathy and 67 percent of those treated with the detuned SWD; 12 percent of the patients who received SWD noted a worsening in their condition, as did 11 percent of those treated with osteopathy and 9 percent in the placebo group. Although the authors report that their study "does not indicate that SWD and osteopathy are equivalent to no treatment," they do conclude that "our results almost certainly attest to the magnitude of the placebo response which may be achieved when harmless treatments are applied with conviction." The study, "Controlled Comparison of Short-Wave Diathermy Treatment with Osteopathic Treatment in Non-Specific Low Back Pain," appeared in the June 1 issue of *Lancet*.

MEETINGS

Power Line Contractors... The date for the DOE-EPRI-NY State contractors' meeting, *Review of Contractors Research on the Biological Effects of Electric and Magnetic Fields Associated with High Voltage Transmission Lines*, has been officially set for November 5-7 at the Radisson Mark Plaza Hotel in Alexandria, VA, (703) 845-1010 or (800) 228-9822. There will also be two workshops, one on dosimetry on November 4 and one on mechanisms on November 8, but these sessions will be restricted. When making hotel reservations, mention "DOE Contractors Review" to get a reduced rate. For more information, contact Dr. William Wisecup, Aerospace Corp., Suite 4000, 955 L'Enfant Plaza, SW, Washington, DC 20024, (202) 488-6328.

1986 Gordon Conference...A Gordon Conference is being planned for the week of June 8-13, 1986 in New Hampshire to discuss the biophysical and biochemical effects of electromagnetic fields that can influence growth and excitation processes. The registration fee will be approximately $250, including room and board. The conference follows the annual meeting of the Bioelectromagnetics Society, which will be held in Madison, WI, next year. For more information, contact Professor Howard Wachtel, University of Colorado, Boulder, CO 80309, (303) 492-7327, or Professor Betty Sisken, University of Kentucky, Lexington, KY 40506, (606) 258-5796.

EMI for Non-EMIers...R&B Enterprises is introducing a new short course, *EMI for Non-EMI Personnel*, to provide an overview of the "basic hows and whys of EMI/EMC" for those "who want to feel more secure and confident when discussing EMI/EMC." The one-day course will be offered in Philadelphia, PA on October 10. The fee is $345. Additional details from: Greg Gore, R&B Enterprises, 20 Clipper Road, West Conshohocken, PA 19428, (215) 825-1960.

MILITARY SYSTEMS

Effect of Standards... In April 1985, NATO's Advisory Group for Aerospace Research and Development (AGARD) hosted a series of two-day lectures in Lisbon, Paris and Rome on *The Impact of Proposed RF Radiation Standards on Military Operations* (AGARD Lecture Series No. 138). The invited speakers were John Mitchell, Col. Roger Graham and Dr. Jerome Krupp of the U.S. Air Force, Dr. Carl Durney of the University of Utah, Dr. Bill Guy of the University of Washington, Dr. Norbert Roberts of the University of Rochester and Dr. J. Bernhardt of the Institute for Radiation Hygiene in West Germany. Dr. Tom Rozzell of the Office of Naval Research attended the Lisbon lectures and summarized them for the June/July issue of the *Bioelectromagnetics Society Newsletter*. The following is based on Rozzell's report: Krupp reviewed the results of the long-term, low-level exposure study conducted by Guy for the Air Force: "The overall conclusion was that no cumulative ill effects could be attributed to the life-long exposure at absorption rates of 0.4 W/Kg or less." Krupp is the project officer for the study (see *MWN, July/August 1984, March and June 1985*). Krupp told the audience, "Rational review of the existing data provides no reason to predict adverse consequences from lifespan exposure to currently allowable levels of RF radiation." Graham discussed incidents of accidental overexposures to RF energy. He said, "In every case where the exposed person was an Air Force employee...they are kept under medical surveillance throughout their lives in order to detect any harmful effects that might develop." But, Graham added, medical examinations of those overexposed "have shown few, if any, consistent clinical patterns." Neurological and psychological exams have also failed to indicate any trends — except for anxiety in cases where the individuals have been concerned over their exposure. The full texts of the lectures are available from the National Technical Information Service (NTIS), Springfield, VA 22161.

National Communications Systems Expansion... The Defense Communications Agency (DCA) and the Air Force (AF) have announced plans to construct a Northeast Regional Communications Facility (NRCF) in western Massachusetts, but citizens and elected officials are resisting the proposal. The project was first described in a notice of intent to prepare a draft environmental impact statement (EIS) published in the *Federal Register* on March 28 (50

FR 12360). But most citizens in Hawley, MA, where as many as 40 transmitter towers and one microwave receiver would be sited, first learned of the project on May 15, when AF officials held a public meeting there; a second meeting was held the next day in nearby Granby, MA, near the Westover Air Force Base where the operations and receiver facilities are planned. Angered when the AF informed them that the formal comment period ended on June 1, citizens contacted their Congressman, Silvio Conte, who persuaded AF officials to extend the deadline to July 1. Conte, who, as the ranking Republican on the House of Representatives' Committee on Appropriations, wields considerable influence over the funding of the $22.7 million project, subsequently vowed to block the project after he learned that no money has yet been appropriated for it. And officials of Franklin County, which contains Hawley, have hired the Boston law firm of McGregor, Shea & Doliner to represent them in their fight to block the system. An AF spokesman confirmed that the Pentagon will proceed with development of the project, including preparation of an EIS, but added that the scope of the EIS will be expanded to consider alternatives to the Hawley site. He admitted that this change was made "because of what Conte said." A two-page background paper and a four-page proposal summary, prepared by the AF before Conte became involved, explain that the Hawley-Westover AFB sites are clearly the best alternatives and that failure to construct the NRCF would "significantly increase the risk of potential damage and/or embarrassment to the U.S. government because of delays in communications which implement/effect actions and strategies as means of implementing U.S. government policies." According to the documents, the NRCF would operate between 3 and 30 MHz with an average power output of 10 kW and a maximum average of 20 kW. The 20-watt microwave link between the Hawley site and Westover AFB will operate in the 1800 MHz band. The draft EIS is due to be completed by the late summer or early fall and the final EIS is planned for early 1986; the AF's spokesman conceded that the expanded scope could delay completion. The AF hopes to begin construction on the project in 1986 and to start operating the facility in mid-1987. For more information, contact: Major Ken Small, USAF/LEEV, Bolling AFB, Washington, DC 20332, (202) 767-4156.

OVENS

Appliance Standards... The U.S. Court of Appeals for the District of Columbia has ruled that the DOE must reconsider its 1982 decision not to set efficiency standards for major appliances, including microwave ovens. The July 16 ruling is a legal victory for a coalition of consumer groups and state governments that has sought a federal efficiency standard since the DOE concluded that such standards could not be economically justified given the potential energy savings (see *MWN*, January/February 1983). Industry officials are concerned that the addition of federal standards to the existing patchwork of state rules will cause havoc. Jack Langmead, vice-president of the Gas Appliance Manufacturers Association, told *The Washington Post* (July 17), "What we need is a single national standard to straighten out this massive confusion."

POWER LINES

Planning a Power Line...A new Oregon-to-California 330-mile transmission line is not scheduled to begin construction for another two years or to be turned on until 1990, but planning for the $400 million project is well under way. 34 public meetings were held in May to identify public concerns in an effort to select a suitable corridor for the power line. The California-Oregon Transmission Project (COTP) is being managed by the Transmission Agency of Northern California, with the participation of the federal government, state agencies, and municipal and investor-owned utilities in California. The COTP plans to build a 500 kV AC transmission line and new substations and to upgrade an existing 230 kV line to 500 kV so that California and the Pacific Northwest can sell and exchange power. (The Transmission Agency, composed of 15 publicly-owned electric utilities, was set up by the state of California in 1984 to develop a power line "in an environmentally and economically sound manner.") Six public workshops were held in July to discuss the siting of the line. After further public review in November, an environmental impact statement will be prepared, due for completion by May 1986. Laura Edlin, public affairs director for the project, told *Microwave News* that public involvement is "critical" to the planning of the line. The project is publishing a newsletter to keep interested parties informed. Contact the COTP, PO Box 660970, Sacramento, California 95866....Meanwhile, a feud is brewing as Bonneville Power increases the price Californians must pay for electricity imported over the Pacific Intertie, an existing power line connecting Oregon and California. Much of the new cost stems from the ill-fated nuclear reactors of the Washington Public Power Supply System. For details, see the July 8 *Wall Street Journal*.

STANDARDS

In Finland... The Finnish government's occupational health bureau has issued a proposal to limit exposures to stray RF fields from plastic sealers. Over an eight-hour period, maximum worker exposures would be 60 V/m for electric fields and 0.2 A/m for magnetic fields. For shorter time periods, exposures could exceed these levels up to a one-minute maximum of 300 V/m and 0.8 A/m for electric and magnetic fields, respectively. The proposal, which is available in Swedish and Finnish and which is scheduled to be adopted at the beginning of 1986, is available from the Standards Information Center, NBS, Technology Bldg., Room B166, Washington, DC 20234, (301) 921-2092. Ask for TBT No. 85.73.

C63 Ballots... Subcommittee 1 on Techniques and Developments of the Accredited Standards Committee C63 on EMC has three draft proposals up for a vote: (1) An addition to C63.4 on EMC measurements to include the

"Methods of Measurement of Radio Noise Emissions from Medical Devices" and a proposed addition to either C63.4 or a planned immunity document on "Methods of Measurement of Electromagnetic Immunity of Medical Devices." These proposals are in their third drafts and are dated April 1985 (see *MWN*, June 1984). Ballots are due by July 31. (2) The extension of C63.2 on EMC instrumentation to 40 GHz. At present the C63.2 standard only covers frequencies up to 1 GHz. Ballots on the proposal, dated May 22, are due by August 9. (3) The June 24 revision of C63.12-1984, *Recommended Practice on Procedures for Control of System Electromagnetic Compatibility.* Votes are due by August 30. For more information, contact Fred Huber, Jr., IEEE Standards Office, 345 East 47th St., New York, NY 10017, (212) 705-7960. C63's Subcommittee 1 has scheduled a meeting for August 19, immediately preceding the *IEEE 1985 International Symposium on EMC,* to be held in Wakefield, MA, August 20-22.

Change at ACGIH... Herbert Jones has retired as chairman of the American Conference of Governmental Industrial Hygienists' (ACGIH) Physical Agents Threshold Limit Values (TLV) Committee and has been replaced by David Sliney of the U.S. Army Environmental Hygiene Agency at the Aberdeen Proving Ground in Maryland. Sliney is already a member of the TLV committee and Jones is expected to continue to work with the ACGIH group, which sets standards for exposures to non-ionizing radiation as well as to noise and to heat stress.

Other Developments... The National Electrical Manufacturers Association (NEMA) is seeking comments on its proposed procedure for *Evaluating Ground Fault Circuit Interrupters for Response to Conducted RF Energy,* (February 25, 1985). For more information, contact: Manager, Engineering Dept., NEMA, 2101 L St., NW, Washington, DC 20037....A new standard, *Electrical and Mechanical Characteristics for Terrestial Microwave Relay System Antennas and Passive Reflectors* (ANSI/EIA) 195-C-1985, has been approved by ANSI's Board of Standards Review and should be available soon....The SAE's Committee AE-4 will meet on August 19 in Wakefield, MA, before the IEEE EMC meeting; see above.

ULTRASOUND

More on SCEs... In our April issue, we reported that a group from the University of Rochester had published a paper in *Science* (March 15) announcing that it had failed to replicate earlier findings that diagnostic ultrasound can increase the frequency of sister chromatid exchanges (SCEs), indicating a potential mutagenic and carcinogenic hazard. That paper has now generated two critical comments. Dr. Robert Bases of the Albert Einstein School of Medicine in the Bronx, NY, notes that the initial findings of an increased frequency of SCEs "has been confirmed and extended in publications from five laboratories in the United States and elsewhere." He posits that the mechanism of interaction may be the release of free radicals by pulsed ultrasound. The letter from Bases, who was one of the coauthors of the original SCE paper, appeared in the May 10 issue of *Science*, as did a reply by Drs. Morton Miller and Victor Ciaravino of the University of Rochester. Dr. Alice Martin of the Northwestern University Medical School in Chicago, IL, also wrote to *Science* (July 19), charging that, in their reply to Bases, Miller and Ciaravino had "erroneously present[ed] our work as supporting the hypothesis that ultrasound has no effect on SCEs." Martin reiterated her opinion that "the question of possible bioeffects of ultrasound is still unresolved." (See A.O. Martin, *Journal of Clinical Ultrasound, 12,* 11, 1984.)

VDTs

Workers' Compensation Settlement...A San Francisco, CA, legal writer has received a $15,000 settlement from her former employer's insurance company after filing a workers' compensation claim alleging that VDT use caused her debilitating eyestrain. Five ophthalmologists examined writer Jeanne Robinson and, though none clearly supported her claim, defense attorney Kevin Haney told *Microwave News* that his clients agreed to an out-of-court settlement to "get the thing disposed of." Judge Jane O'Neill of the California Workers' Compensation Appeals Board approved the settlement on March 5, specifically citing materials submitted by ophthalmologist Dr. William F. Hoyt, but Hoyt recently claimed in an interview that Robinson's claim is "fraudulent and has no merit whatsoever."

ETC...

Assorted Notes...*The Journal of Microwave Power* has a new look. Volume 20, Number 1, the first issue of 1985 and the first under the editorship of Dr. W.A. Geoffrey Voss, has an eight-and-a-half by eleven-inch format and features nine research papers and a section on patents and book reviews. Among the papers is a re-analysis by Dr. Allan Frey of Dr. Budd Appleton's data on cataract risks due to exposure to microwave radiation — first reported in the November 1984 issue of *Microwave News*. The *Journal* is available free with membership in the International Microwave Power Institute (IMPI). Dues are $75.00 a year. Contact: IMPI, Tower Suite 520, 301 Maple Ave. West, Vienna, VA 22180, (703) 281-1515....Lightning strikes may not be random. According to an article in *The Washington Post* (June 27), Drs. Raul Lopez and Ronald Holle at NOAA's Environmental Research Labs in Boulder, CO, have found that local topography plays a major role in determining where a lightning bolt will strike. One study area was found to be hit by lightning more than 25 times each summer (see also the July 13 *Science News*) ....Radio Marti, U.S. broadcasts to Cuba, went on the air on May 20, and all those fears of Cuban retaliation by jamming American radio stations have not materialized. But Radio Marti has brought about one major policy change: according to a dispatch by Reuters on June 18, Cuban radio has lifted its ban on Frank Sinatra, which has been in effect since the early 1960's. "Come Fly With Me" is once again on the Cuban airwaves.

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Electropollution Symposium

Howard University, Washington, DC
September 9, 1985

Active workers in the field of radiofrequency and microwave biology are invited to submit an abstract. Best five will receive awards for travel and accommodations. Deadline for applications is August 26.

Contact:

Professor Richard Millis
Howard University
(202) 636-6933.

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Human Tumor Cells Thrive in ELF Magnetic Fields

Human tumor cells proliferate more easily and are more immune to attack when exposed to power line fields, according to Dr. Jerry Phillips of the Cancer Therapy and Research Foundation in San Antonio, TX.

Because the field effects persist for months after exposure to extremely low frequency (ELF) radiation, Phillips argues that 60 Hz fields "are capable of producing significant permanent changes in cellular structure and function."

Phillips's results, presented in a series of recent papers, may be the first step in explaining the abnormally high cancer rates identified among people exposed to electromagnetic fields (EMFs). "Our studies are very much in concert with the epidemiological studies that have been published," Phillips told *Microwave News* in a telephone interview.

A recent review of epidemiological surveys by Dr. Tom Tenforde of the Lawrence Berkeley Lab in California indicates that 15 of 17 reports showed "some apparent correlation between cancer and EMFs" (see *MWN*, March/April 1986). New findings continue to support an association between ELF and cancer (see *MWN*, May/June 1986).

(continued on p.13)

Workers Claim Radar Accident at Maine Shipyard

As many as 23 workers may have been exposed to high levels of radar radiation at the Bath Iron Works (BIW) shipyard in Portland, Maine, on March 19. BIW officials contest the men's claim that a U.S. Navy ship's radar was accidentally turned on while they worked nearby.

Most of the men reported facial burns, red arms and suntans following the alleged incident, even though it rained that day. Among the other most common complaints were severe headaches, irritated eyes, nausea and exhaustion. At least one worker says he is still suffering severe ill effects and has not returned to work.

The radiation came from an AN/SPS-49 long-range air-search radar aboard the U.S.S. Taylor, a guided-missile frigate, according to officials of Local 6 of the Industrial Union of Marine and Shipbuilders of America, which represents the workers. The radar was built by the Raytheon Co. of Wayland, MA.

A BIW spokesman told *Microwave News* that the radar was "sector-blanked" — that is, it could not have exposed the men in the shipyard. But Jim Mackie, the chief steward of Local 6, disagreed: "All somebody had to do was hit one button and the sector-blanking would have been turned off," he said in an interview.

Mackie pointed out that, at the time the radar is believed to have been on, walkie-talkies stopped working in the yard and fire alarms went off in the drydock for no apparent reason.

(continued on p.14)

HIGHLIGHTS

EPA's Four Options for Public Exposures to RF/MW Radiation

The Environmental Protection Agency (EPA) has proposed options for protecting the public from radiofrequency and microwave (RF/MW) radiation exposures: maximum specific absorption rates (SARs) of 0.04, 0.08 and 0.4 W/Kg, which translate into power densities of 100, 200 and 1,000 uW/cm², respectively. A fourth option is to take no official regulatory action (see box).

Which option EPA will finally select depends on numerous scientific and policy issues; in its *Federal Register* notice, the agency asks for public comments on how these issues should be resolved. Many key questions are unclear: EPA indicates that frequency-dependent power densities would be set based on the SARs but does not specify where, between 10 kHz and 100 GHz, the levels would change — that is, what is the resonant frequency range.

When and if EPA adopts — and the President approves — public exposure limits, formally called "Federal Guidance," affected agencies will be responsible for implementing them.

EPA began work on the guidance in the late 1970s and, in 1982, asked for public comments on six questions related to standard-setting (see *MWN*, January/February 1983). In 1984, the agency was about to propose what is now called option 1 (100 uW/cm²), but backed off in the face of opposition from EPA's policy office (see *MWN*, June and July/August 1984 and September/October 1985).

Since 1984, EPA's Office of Radiation Programs has waged an uphill battle against its own policy office and the Office of Management and Budget to propose the guidance. Delays followed delays and now, instead of proposing a single set of limits, EPA is again seeking public comments on a wide range of issues. According to the current timetable, EPA will issue a final guidance in December 1987. But it is more likely that the agency will be forced to issue a new proposal — and yet again ask for public comments — when it finally chooses one of the options. If so, the final guidance will be delayed at least until 1989.

Following a series of copyediting snafus, the EPA proposal finally appeared in the *Federal Register* on July 30 (51 *FR* 27,318) — more than six weeks after its release on June 12. Comments are due by October 28. EPA is sponsoring a public hearing September 22-23 at the GSA auditorium (18th and F Sts., NW) in Washington, DC.

Key Issues To Be Settled

At the heart of the decision on which option to select are three key questions: What margin of safety should EPA use to protect the public? How should it deal with non-thermal effects? and How should it resolve the question of RF/MW-induced carcinogenesis?

EPA states that adverse effects "begin to occur" between 1 and 4 W/Kg and that the exposure limits will be derived by applying a suitable safety factor — between 10 and 1,000 — "to compensate for unknowns and uncertainties."

The public health significance of non-thermal effects, at SARs of less than 1 W/Kg, "is not well understood," according to EPA: "The overall implications for human health of low-level non-thermal effects [are] not clear... further research is required to determine... whether they constitute a hazard to human health."

EPA states that it "believes RF radiation should now be treated as a non-carcinogen." Nevertheless, citing "some preliminary and unconfirmed studies," principally the long-term exposure study at the University of Washington in Seattle, in which rats exposed to an SAR of 0.4 W/Kg had increased rates of tumors, the agency left the door open to changing its mind, noting that the issue of carcinogenesis "is not yet resolved and could affect EPA's assessment."

Among the factors which will influence EPA's choice of the appropriate margin of safety are: (1) undetected sensitivities to radiation; (2) validity of animal data for gauging risks to humans; (3) lack of long-term exposure studies; (4) reliability of extrapolating from animal data to humans; (5) natural environmental and genetic variations among humans; (6) variations in environmental exposure conditions; (7) ill-characterized non-thermal effects; (8) lack of sensory mechanisms for warning against overexposure; (9) adequacy of the human thermoregulatory system; and (10) absence of a clear threshold for adverse effects.

Dealing with Shocks and Burns

"It is impractical to specify numerical electromagnetic field intensity limits that prevent all possible shock and burn effects," according to EPA. Under the three specific options, EPA estimates the induced currents in a grounded individual at 3 MHz to be 45 mA, 247 mA and 553 mA for options 1, 2 and 3, respectively. EPA points out that only option 1 results in a threshold for RF burns of less than 100 mA, as proposed by the National Institute for Occupational Safety and Health.

EPA advises that, "as a minimum, low frequency fields

U.K.'s NRPB Proposes ELF, RF & MW Standards

The United Kingdom's National Radiological Protection Board (NRPB) has just published proposed standards for occupational and general public exposures to non-ionizing radiation below 300 GHz. For occupational exposures to radiofrequency (RF) and microwave (MW) radiation, NRPB recommends the same levels as those set by the American National Standards Institute (ANSI) in 1982; for occupational exposures at 50 Hz, it proposes 30 kV/m and 10 mT for the electric and magnetic fields, respectively. For all frequencies, general population exposure limits are no more than 40 percent of the occupational levels.

NRPB has invited comments on its proposal and plans to issue a final standard by early 1987. *Advice on the Protection of Workers and Members of the Public from the Possible Hazards of Electric and Magnetic Fields with Frequencies Below 300 GHz: A Consultative Document* (May 1986) is available from NRPB, Chilton, Didcot, Oxon OX11 0RQ, U.K.

Microwave News will publish a full report on the NRPB proposal in our next issue.

EPA's Four Options

Excerpts from EPA's Federal Register *notice.*

Option 1: Guidance Based on an SAR of 0.04 W/Kg. Controlling public exposure by limiting whole-body average specific absorption rates (SARs) to 0.04 watts per kilogram (W/Kg) for frequencies above 3 megahertz (MHz) and by limiting electric field intensity to 87 volts per meter (V/m) and magnetic field intensity to 0.23 amperes per meter (A/m) at frequencies below 3 MHz.

This option represents a "no effects" level by protecting against thermally-related health effects in humans, including most sensitive subgroups of the population. No measurable changes in core temperature would occur at this level nor would any thermoregulatory responses be initiated. This level is consistent with the usual practice of providing substantially more protective standards (here, by a factor of 10, when compared to, for example, the 1982 ANSI voluntary standard of 0.4 W/Kg) for the public than those recommended for occupational exposures. This level might be viewed as unnecessarily stringent in that the health protection provided may not be commensurate with its cost, particularly in view of the present uncertainties surrounding low-level and nonthermal effects.

Option 2: Guidance Based on an SAR of 0.08 W/Kg. Controlling public exposure by limiting whole-body average SARs to 0.08 W/Kg for frequencies above 3 MHz and by limiting electric field intensity to 275 V/m and magnetic field intensity to 0.73 A/m for frequencies below 3 MHz.

This option also effectively represents a "no effects" level by protecting against thermally related health effects in humans, including most sensitive subgroups of the population. No changes in core temperature should occur at this level nor should any thermoregulatory responses be initiated. Also consistent with the usual practice of generally providing more protective standards for the public than those recommended for occupational exposures, this level differs from Option 1 in that it is lower than, for example, the 1982 ANSI guide by a factor of 5 rather than a factor of 10, as given in Option 1. This option is similar to the Massachusetts standard, to the IRPA guideline in the resonant frequency range and to the exposure limits recently recommended by the NCRP. The agency is particularly interested in comment on this option, because 42 U.S.C. 2021(h) states that the administrator shall consult with the NCRP, among others, on radiation matters.

Option 3: Guidance Based on an SAR of 0.4 W/Kg. Controlling public exposure by limiting whole-body average SARs to 0.4 W/Kg for frequencies above 3 MHz and by limiting electric field intensity to 614 V/m and magnetic field intensity to 1.63 A/m for frequencies below 3 MHz.

This option should protect against thermal effects except in possibly more susceptible or sensitive people or possibly at high ambient temperatures and humidities. This level corresponds to the lower end of the range postulated to be associated with the onset of thermoregulatory responses in humans. Effects that occur below this level do not, for the most part, seem to be caused by generalized heating. The 1982 ANSI standard, set at this level, does not differentiate between occupational and public exposure but noted, "...these guides are offered as upper limits of exposure, particularly for the population at large." Various groups in the broadcasting industry have indicated to EPA their willingness to comply with a guideline at this level (letters placed in the central docket). The agency is particularly interested in comment on this option, because it is similar to the 1982 ANSI guide voluntarily adopted by much of the broadcast industry and is to be used by the FCC to determine the need for environmental impact analyses for new and renewal license applications.

Option 4: Conduct Other Activities in Lieu of Adopting Federal Radiation Protection Guidance for RF Radiation. In lieu of adopting Federal Guidance for RF radiation, establishing public awareness programs to distribute information on health effects and environmental measurements as well as provide technical assistance to states and federal agencies.

This is a nonregulatory option, and it would provide public health protection only as it is realized indirectly through the advice and technical assistance provided by EPA to federal agencies, states or industry. Taking no regulatory action at this time could permit any further regulatory action to be based on more refined biological, technical and economic analyses. For example, allowing more time for additional research to identify and quantify adverse health effects in the population may result in more improved risk estimates. It is not clear whether this approach will meet the perceived need of federal agencies, states or industry that have requested uniform federal exposure guideliness, and EPA seeks comments on this issue.

should be limited to intensities that prevent accident-causing startle reactions in ungrounded individuals who may momentarily contact grounded objects" in high RF fields.

In addition, the EPA proposal:

- Specifies no limits for peak intensities of pulsed fields;
- Suggests limits that are ten times less stringent for exposures of less than six minutes in any one hour, as long as the total energy absorbed is no greater than would be absorbed in one hour under continuous exposure;
- States that it is "impractical to distinguish between partial-body and whole-body exposures" and proposes that the limits apply to all exposures;
- Makes no special provisions for modulated fields because the scientific data "is not considered to be sufficiently developed";
- Excludes exposures from medical devices and consumer products.

EPA's economic analyses (see *MWN*, September/October 1985) show that even the most stringent controls (option 1) would have a relatively minor impact on federal RF/MW activities — EPA notes that even though some agencies differed with these estimates, one part of the Defense Department agreed.

Comments on the EPA options should be sent to: Central Docket Section (LE-131), U.S. EPA, Attention: Docket No.A-81-43, Washington, D.C. 20460.

The EPA Office of Radiation Programs recently moved. The new telephone numbers are: Dave Janes and Doreen Hill at (202) 475-9626; Norbert Hankin at (202) 475-9630. Their mailing address remains the same.

Wertheimer-Leeper ELF Exposure Estimates Confirmed

Reports from two ongoing epidemiological studies have confirmed the reliability of the coding scheme developed by Dr. Nancy Wertheimer and Ed Leeper to estimate human exposures to extremely low frequency (ELF) magnetic fields.

At the Bioelectromagnetics Society (BEMS) meeting in Madison, WI, in June, members of both study teams reported that detailed magnetic field measurements supported the Wertheimer-Leeper claim that residential exposures can be estimated by checking the wiring configuration near a given home. The two studies, funded by the New York State Power Line Project, are designed to test the Wertheimer-Leeper finding of a link between exposures to weak alternating magnetic fields and cancer (see *MWN*, September 1983).

Neither research group presented any results at BEMS on the key question of the possible relationship between ELF fields and cancer. These are expected to be ready for the Department of Energy and Electric Power Research Institute (EPRI) contractors review to be held in Denver, CO, in November.

Ground Currents

Bill Kaune of the Battelle Pacific Northwest Labs concluded that the "Wertheimer-Leeper method of wiring classification is correlated with residential magnetic fields" and that "our data are supportive of the idea, first suggested by Wertheimer and Leeper, that ground currents are a significant source of residential magnetic fields." Kaune pointed out that there is still considerable variability in magnetic fields within each category.

Drs. Frank Barnes and Howard Wachtel of the University of Colorado in Boulder reached a similar conclusion: on average, the magnetic fields are determined by sources outside the house, in a manner consistent with the Wertheimer-Leeper coding scheme. They too found that there can be substantial variation among different houses within a given class.

Asked whether he agreed with Kaune on the importance of ground currents, Wachtel told *Microwave News* that the greatest contributions to the magnetic fields come from outside the house and that they might be due to the ground currents. Household power does not affect the magnetic fields inside the home, he said.

In a telephone interview, Dr. David Savitz, an epidemiologist at the University of North Carolina in Chapel Hill who is in the process of analyzing the Colorado data, called the new findings "a clear confirmation of the Wertheimer-Leeper exposure methodology."

This classification scheme has been criticized in the past. For instance, in an evaluation for EPRI, Daniel Roth, a consultant, reported that, "It is difficult...to accept Wertheimer and Leeper's conjecture that wiring configuration was a surrogate measure for magnetic fields..." (see *MWN*, May 1985).

Nevertheless, the method has won a considerable following — perhaps too great. Wertheimer and Leeper are now worried that others are using their coding system without first checking as to whether there is a correlation between local wiring and household magnetic fields in specific study areas. They are particularly concerned about the use of their technique in Europe (see "From the Field" on p.9).

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VDT Pregnancy Studies Increase Uncertainty Over Possible Hazards

New and previously released epidemiological studies presented in May at a conference on video display terminals (VDTs) in Stockholm, Sweden, suggested that VDT work might adversely affect pregnant women, although most speakers dismissed the possibility of any risk.

Of the five major studies presented, four showed some positive associations. Two indicated increased rates of cardiovascular abnormalities in children born to women who used VDTs. A third suggested a tendency toward increased rates of spontaneous abortions among women who worked moderate amounts of time at VDTs — but not among those who worked long periods at VDTs. And the fourth found higher rates of abnormal pregnancies among VDT operators who were under stress.

Only one scientist reported an increased risk and advised against VDT work during pregnancy. Several researchers, while discounting their positive results as anomalous, called for further epidemiological studies.

Heart Defects In Sweden and Finland

A Swedish study of more than 4,000 births between 1980 and 1983 found 57 "significant malformations" among offspring of women with some or considerable VDT exposure, compared to 9 such malformations among babies of those with little or no exposure — yielding an odds ratio of 1.9, or a near doubling of the risk of defects. Lead researcher Peter Westerholm of the Swedish Trade Union Confederation admitted that this difference was of borderline statistical significance but concluded that there was no increased risk.

Among the 57 births involving serious defects, Westerholm and coworker Anders Ericson of Sweden's National Board of Health and Social Welfare found 12 cases of cardiovascular malformations, but they found no defects of this type in the control group.

The study team used computerized personnel records to identify job categories; employers and trade union officials subsequently estimated VDT use.

Westerholm reported that the group of women who spent moderate amounts of time doing VDT work had the highest rate — 3.4 percent — of significantly malformed babies, compared to 1.6 percent or less for those who did either more or less work. He called this finding "paradoxical," saying

that the highest rate should have occurred among the women with the greatest exposures.

Dr. Karel Marha of the Canadian Center for Occupational Health and Safety in Hamilton, Ontario, responded from the audience that neither Westerholm's study nor any of the others controlled for "unintended" exposures to terminals – the amount of time a woman is not operating a VDT but is nonetheless working near one. "I would like to see an epidemiological study where exposure is well-defined relative to the location of the VDT," he said.

A second study also showed an increase in cardiovascular abnormalities among children born to women who used VDTs. Here again, the increase occurred only among part-time VDT operators. A group led by Dr. Kari Kurppa of the Institute of Occupational Health in Helsinki, Finland, reported 13 such birth defects among children of exposed women, compared to 8 among offspring of unexposed women (odds ratio of 1.6). Of the 13, 8 were among part-time workers (less than 4 hours/day), compared to only 3 among controls.

Kurppa's team had previously reported the results of this case-referent study in *The Lancet* (December 8, 1984) and in the *Scandinavian Journal of Work, Environment and Health, 11,* pp.353-356, 1985 (see *MWN,* January/February 1985 and March/April 1986, respectively).

The seemingly inconsistent finding of increased pregnancy risks among operators who worked part-time at VDTs showed up yet again in the presentation by Canadian researcher Dr. Alison McDonald. Reporting on data first released in 1984, she pointed out an increased rate of abnormal pregnancies among moderate VDT operators but not among more regular users.

McDonald discounted her positive results, not only because the dose-response relationship was unusual but also because the rate of spontaneous abortions among non-VDT workers was lower than expected. She attributed the positive findings to recall bias and concluded that there is "no convincing evidence that use of VDTs during pregnancy increases birth defects or spontaneous abortions."

Dr. Henryk Mikolajczyk of the Institute of Occupational Medicine in Lodz, Poland, was the only speaker who concluded that VDTs pose a risk to pregnant women. His survey of 185 women, who worked for the Polish Airlines (135 women) or for a building construction bureau (50 women), indicated that work at VDTs under high-stress conditions may harm fetal development.

At the airline office, where the women experienced high levels of stress, the 89 VDT operators suffered 22 spontaneous abortions, compared to 8 among the 46 controls. At the other, low-stress office, however, none of the VDT users miscarried, while 5 of the controls reported spontaneous abortions.

VDTs, Stress and Smoking Linked to Problem Pregnancies

A new, two-part study indicates that VDT exposure, stress and smoking are all related to abnormal pregnancy outcomes, leaving open the possibility of a link between VDTs and birth defects and/or spontaneous abortions.

Swedish researchers Anders Ericson of the National Board of Health and Social Welfare and Dr. Bengt Kallen of the University of Lund concluded that, "The question of a possible reproductive hazard associated with video screen work is by no means finally settled." They believe that the possible risk of birth defects is greater than that of spontaneous abortions, though they doubt that VDT work increases either significantly.

After examining national birth registry and medical records of approximately 10,000 pregnancies, Ericson and Kallen reported indications of an increased risk of problem pregnancies among women with the greatest VDT exposure. Interestingly, of the three job categories classified as "high" exposure groups – computer personnel, travel agency clerks and insurance clerks – computer personnel suffered a markedly higher rate of significant infant malformations than did the other two groups, accounting for the increase of the whole "high" exposure group relative to the "low" and "medium" groups.

Ericson and Kallen also compared pregnancy outcomes from 1976-1977 to those from 1980-1981 and observed "faint indications" of increased spontaneous abortion and malformation rates in the latter period, when VDTs were more widely used. The number of spontaneous abortions in 1976-1977 was lower than expected, the authors warned.

Investigating further, Ericson and Kallen ran a case-control study of 522 cases of significant birth defects and spontaneous abortions compared to 1,032 controls. As in part one, they analyzed the data according to low, medium and high VDT exposures.

They found a statistically significant, dose-dependent association between VDT work and birth defects but cautioned that they were unable to separate VDT work from other variables. "If a relation between birth defects and video screen work is actually present," they wrote, "it is most likely an effect of stress at work, perhaps combined with smoking."

The researchers noted that they included only spontaneous abortion cases for which women were hospitalized and thus may have excluded early miscarriages; they also cautioned that the data collected by questionnaires in the second part of the study may have suffered from recall bias.

The study papers, "An Epidemiological Study of Work with Video Screens and Pregnancy Outcome: I. A Registry Study" and "II. A Case-Control Study," appeared in the *American Journal of Industrial Medicine, 9,* pp.447-457 and pp.459-475, respectively, 1986. They were originally published last year in Swedish.