Occupational Studies: There are two primary questions that need to be answered in this area. One is whether the electrical workers identified in the published associations between leukemia and electrical work really do have exposure to higher levels of EMFs than other occupations. And the second important question is whether populations with proven high exposure for long duration really have an excess of leukemia or other cancers. Ideally, at least six conditions should be met for the latter study: (1) The population must be large enough for the study to have adequate statistical power to have a high probability of detecting an association between leukemia and EMF exposure, if one exists; (2) it must contain a significant proportion of workers exposed to EMFs considerably above background; (3) it must contain a significant portion of workers with long-term exposure; (4) written records regarding job assignments of study subjects must be available; (5) it must be feasible to measure EMF exposures of present day jobs and to infer past exposure from these measurements. This implies that the exposure in any specific job must have remained constant or be predictable, based on the job duties and location; and (6) there must be a way of identifying cases of leukemia or other cancer either through population-based disease registries or through company records (medical, insurance, etc.). It must be emphasized that any studies of occupational groups must include a strong effort to identify concomitant carcinogenic exposures, for example, solvents and PCBs.

Opportunistic Epidemiology: Efforts should be made to identify populations with higher than average exposures to EMFs. Examples of this might include electric blankets or resistance ceiling heating. If it is true that very high electric (E) and magnetic (B) fields are found under electric blankets and if high EMFs cause leukemia or other cancer, then electric blanket users should be at risk of leukemia or other cancers. This question could easily be added to existing questionnaires of case-control studies of adult leukemia, and there is no reason to think that objective reproducible information would not be forthcoming.

Life Exposures: This category probably belongs more to the exposure assessment consideration, but nonetheless the human studies are impaired by our general lack of knowledge on ambient EMF exposures encountered in various living activities. A greater knowledge of these exposures would probably result in some hypotheses that could be tested through population studies.

Costs and Time: A good study of children's cancer, particularly leukemia, taking a careful look at residential and public exposures would probably take about three years to complete and would cost approximately somewhere between $750,000 and $1,000,000. In the occupational studies, characterizing the exposure of electrical workers versus non-electrical workers would take between one and two years, and would cost approximately $250,000. The study of high exposure/long duration employees in a cohort followed by a case-control study would probably take about five years and would cost in the low millions. The opportunistic epidemiology, if attached to ongoing or planned case-control studies, would have a relatively small cost, certainly under $50,000, and would take the same amount of time to complete as the parent study. Life exposures could be studied forever. If answers are provided by the other studies that either incriminate or reduce the chance of there being a risk, then the need for such studies might be increased or decreased.

EXPOSURE ASSESSMENT PROJECTS

Occupational: •Collect occupational exposure data for 60 Hz E- and B-fields. There should be sufficient data to produce various exposure metrics. Ultimately, this will be a long-term effort with large N. Other exposure parameters should be included. Exposure from power lines should be differentiated from that due to other sources. All industry sectors should be sampled including the rapidly expanding service industries, medical services and industries using pulsed fields. The protocols and exposure data should be compatible with efforts directed at the residential and civic sectors. •Evaluate surrogate measures for occupational exposure such as: job titles, specific tasks, proximity to equipment. •Characterize the harmonic content of occupational exposures through spectral analysis at various locations. Characterize contact currents and shocks in the workplace. •Develop a small dosimeter for occupational exposure measurements. Consider the use of a biological indicator for exposure. •Identify unique exposures associated with specific locations and/or industrial processes.

Civic/Public Areas: •Collect 60 Hz E- and B-field exposure data in civic and public areas such as schools and hospitals. The data should be sufficient to generate various exposure metrics. The protocols and data should be compatible with studies in the residential and occupational sections. •Characterize 60 Hz E- and B-fields in schools and other locations such as hospitals and subways. This effort should include harmonics. Sources of exposures in public areas should be identified.

Other: •Assess need for combined exposures to E- and B-fields in animal studies. Evaluate conversion of existing E-field exposure facility to combined E- and B-field exposure facility. •Investigate combination AC and DC transmission line environment.

Laboratory: •Develop protocol to specify lab ambient environments, e.g. geomagnetic fields, 60 Hz levels, control areas. •Design a B-field exposure system with a waveform/temporal menu. This menu should reflect an effort to mimic selected aspects of human exposure. This system would then be used for 60 Hz field effects research on animals. Evaluate modification of existing E-field exposure facility. •Continue mechanistic research with exposures that vary in frequency, amplitude and temporal presentation.

Residential: •Collect 60 Hz E- and B-field exposure data. There should be enough data to produce various exposure metrics, including peak fields, time histograms, etc. The rationale for the metric(s) that are used is required. Ultimately, this will be a long-term effort with a large number of people keeping activity logs. A representative sample of society will need to be selected. Special subsets of the population that are of interest are those living near transmission lines and children. Because of the immensity of the project, an incremental approach is desired. A tractable sample size in one location would be used to establish protocols for expanding the study to several locations. •Perform B-field characterization: look for significant parameters such as diurnal variations; long-term stability; grounding systems; construction practices; geographic location; important sources related to power system and internal sources; spectral analysis to look at harmonics for both E- and B-fields. Determine appropriate meter response to characterize fields: 60 Hz or broadband. •Investigate ion penetration into residences. •Evaluate surrogate measures of residential exposure. •Perform

electric blanket exposure assessment. •Identify unique exposure situations including contact currents from appliances.

TERATOLOGY RESEARCH

Rationale: EPRI has long recognized the shortcomings of previous teratology studies and through research that it sponsored, developed E-field exposure cages free of the technical flaws of previous designs. This equipment is now being used in a teratology study in rats conducted at Battelle Northwest, where rats are exposed to 0, 10, 65 and 130 kV/m. The study was started in December, 1986.

The question was discussed whether adverse effects of B-fields on embryo development should be examined. No serious, scientifically sound studies are presently on record. The concern was voiced that EPRI is getting more and more involved in "defensive science," but with respect to B-fields, that argument was felt not to be applicable because there is no data base. The feeling was expressed that sooner or later, a B-field exposure teratology study would have to be conducted. The issue whether there should be simultaneous exposure to E- and B-fields was decided in favor of one or the other variable only to not confuse the issue and endanger the interpretability of the study results.

There is a need for EPRI to *sponsor a teratology study on B-field exposure* in the very near future. An engineering cost analysis should be initiated to decide whether it is more economical to retrofit the existing E-field exposure chambers presently used at Battelle or to design entirely new exposure chambers. It might be advantageous to combine both exposure possibilities in one piece of equipment for future experiments.

DIRECT CURRENT FIELD RESEARCH

...1. There is an important need for research to clarify the possible long-term effects of air ions and DC E-fields on laboratory animals. As with AC research, this information is needed as part of the overall data base for assessing the potential effects of HVDC transmission lines on people. Specific end points for laboratory animal research include, but are not limited to: •Survival rates; •Incidence of and progression of respiratory disease; •Levels of and/or response to neurotransmitters, e.g. serotonin; and •As a lower priority, consider the need for research on cancer and birth defects. A single, multigenerational study could address most of these end points. **Rationale:** Published results of the EPRI-sponsored air ion research by Kellogg et al. (1985) claim significant effects on mice from long-term air ion exposure, i.e., decreased lifespan. Although the research has been criticized by some on methodological grounds, one of the HVDC science advisors to the state of Minnesota (Bissel 1986) recently concluded that the Kellogg study is sufficiently plausible to deserve replication by EPRI. One of the only other studies to look at long-term air ion exposure, Hinsull et al. (1981), also reported some effects on neonatal survival and on pre-weaning growth rates of rats. Recent studies by Kellogg et al. (1985) and by Bailey and Charry (1984) found no evidence that air ion exposure influenced serotonin levels. However, a recent report by Dowdall and de Montigny (1985) suggested that such exposure can affect the sensitivity of brain cells to serotonin. This finding has now been replicated (de Montigny, personal communication). The serotonin issue, therefore, has not been fully resolved. ***Estimated Cost: $2-3 million.***

2. Short-term studies of humans are needed to assess the following: •Factors influencing perception of DC E-fields, including annoyance levels; •Mental state, including mood and performance; and •Individual differences among people in their responses to air ions. **Rationale:** Research personnel and others who work near HVDC lines report that on occasion, E-fields are noticeable and in some cases, annoying. The latter appears to be related to both field strength and weather conditions. No systematic studies using representative subjects and conditions have been done to evaluate the occurrence of, and factors influencing human perception of DC E-fields. There is also a body of controversial research suggesting that air ions can influence mood and mental state in humans. Research by Charry and Hawkinshire (1981) also indicates there may be significant differences among people in their responses to air ions. ***Estimated Cost: $200,000-$400,000.***

3. Research on HVDC electrical exposures is needed to address: •Identification of chemical ion species in power line environments compared to other situations, e.g. indoor laboratory animal environments; and •Measurements and modeling of the electrical environment where AC and DC transmission lines are in close proximity. **Rationale:** Although good information now exists on the concentrations of air ions produced by HVDC lines, information is lacking on air ion species near such lines. Also, it is important to know how air ions produced by DC lines compare to the air ion environment used in studies of laboratory animals. Preliminary information has been obtained by an EPRI-sponsored study (Georgia Institute of Technology) and this work should continue. ***Estimated Cost: $100,000-$200,000.***

4. Work should begin on study design and protocol for laboratory animal research to assess the possible effects of combined AC and DC fields comparable to those produced by adjacent AC and DC power lines. **Rationale:** Recent research, e.g. Thomas et al. (1986), Blackman et al. (1985), indicate that certain combinations of AC and DC B-fields can produce biological effects in laboratory studies which are not produced by the separate fields. A hypothesis involving cyclotron resonance has been advanced to explain the phenomenon. ***Estimated Cost: $200,000-$600,000.***

5. Work should begin to determine if there is a basis for laboratory animal research to determine if charged aerosols cause biological effects that differ from, or interact with, those that may be produced by air ions. **Rationale:** It is currently assumed that space charge, in the form of air ions and charged aerosols, leads to increased DC E-fields off the right-of-way of a DC line. Further, under some conditions, charged aerosols may be the primary component of DC E-fields off the right-of-way where residences may be located. There is little information available for assessing the possible biological effects of chronic exposure to charged aerosols. ***Estimated Cost: $50,000.***

6. Evaluate the need for and feasibility of epidemiological research involving people who live and/or work near HVDC transmission lines, possibly through a cooperative effort with individual utility groups. **Rationale:** Some preliminary epidemiological research involving HVDC lines has been done, however, with inconclusive and controversial results (e.g. Genereux and Genereux 1980, Nolfi and Haupt 1982). The New England Hydro-Transmission Corporation is investigating the feasibility of such research at the request of the states of New Hampshire and Massachusetts. ***Estimated Cost: $50,000-$75,000 (feasibility study only).***

WHOLE ANIMAL STUDIES ON CANCER ISSUES

The following are the recommended animal studies which have the goal of developing an animal model for studying the

relationship, if any, between exposure to power frequency B-fields and cancer. The review committee emphasized that careful planning, including a review or a workshop on the laboratory data base, would be necessary to generate specific hypotheses for study. "Fishing expeditions" are specifically discouraged. In vitro cellular studies may provide models for "range finding" so that some notion of a meaningful dose metric might be developed to apply in the animal studies.

1. The first study is essentially a "pilot study" and would utilize specific mouse strains selected for responsiveness to cancer-promoting agents (e.g. B6, AKR or others) using treatment groups *such as* (a) [constant exposure over days to low and high fields – the "high" being approximately ten times the "low" field strength]; (b) "Electric blanket" exposure scenario: [eight hours of high exposure followed by 16 hours of low exposure]; (c) Random amplitude and duration [exposures].
2. A "primed" system study using treatment groups *such as* the following: (a) Mouse plus leukemogen plus B-field at $\Delta t = \Delta t$ in frequency and latency; (b) Model plus promoter (e.g. estrogen); (c) Model such as nude mouse, which has immune system deficiencies; (d) Fetal exposure and examine offspring for leukemia.

RISK ASSESSMENT RESEARCH PROJECTS

Rationale: The inability to define "dose" has severely limited investigators' efforts to apply conventional risk analysis techniques to the problems of 60 Hz fields (see the various works of Morgan, et al.). While it probably does not make sense to devote much additional effort to conventional risk analysis until the science is in better shape, there are some important related activities which should be undertaken at this time:

1. Develop materials designed to assist state regulators, members of the judiciary, state legislators, electrical utility managers and others who must deal with 60 Hz field issues to structure and think about the problems they face. Such guidance must include a fair articulation of what the science does and does not say; a fair explanation of which experiences and insights gained in the context of other risks extrapolate to the 60 Hz area and which do not; a clear statement of the importance of maintaining a relative risk perspective and of establishing bounds on the problem; and a clear framing of the choices and value judgments that managers and regulators must make. It would be worth involving several different groups in work of this kind.

2. While at this stage, the central scientific questions of existence of effects, nature of mechanisms and characterization of "dose" should drive the research agenda, a risk analytic perspective may be useful in helping to establish some research priorities and in keeping the research program focused on its basic risk-related objectives. The level of effort devoted to this second task should be modest.

MECHANISMS OF INTERACTION

The following is a listing of the eight recommendations, with an asterisk placed after those areas of research that are currently funded by EPRI, DOE or other sources:
1. (*) Continued research on transmembrane signalling events and the activation by EMFs of cAMP, cellular kinases and other enzyme systems that are controlled kinases.
2. Determination of thresholds for ELF field effects using well-defined in vitro systems and quantitative biological/biochemical end points. These thresholds relate to field amplitude and frequency dependence, temporal variations in the expression of bioeffects and the magnitude of these effects as a function of exposure duration.
3. Devise a sensitive in vitro model for studying the relative potencies of various field exposure regimens (e.g., different on-off cycles using a field intensity that elicits a quantifiable effect during continuous exposures of approximately one hour duration).
4. (*) Additional work on "transcription" and "translation" effects of ELF fields, such as the altered messenger RNA expression and protein synthesis in dipteran salivary gland cells (research by Goodman, Henderson and others).
5. Replication of key experiments conducted in vitro such as the Winters/Phillips studies on growth rate and membrane receptors in human colorectal adenocarcinoma cells.
6. (*) Extend studies on the pineal gland as a potentially sensitive site of ELF field interactions. Explore melatonin interactions with other hormones (e.g., estrogen) that are known to influence cancer risk in certain tissues (e.g., the female breast).
7. Enhance efforts to develop realistic theoretical models of ELF field interactions at the cellular, membrane and molecular levels of biological organization.
8. Initiate studies on synchronized cell populations in vitro to gain information on the cell-cycle-phase dependence of ELF field interactions (i.e., to detect differential sensitivity between quiescent cycling cells, and between G-1, S and G-2 cells in cycling populations).

CONFERENCE CALENDAR

New Listings

May 15-18: **Spring Conference of the Society of Telecommunications Consultants (STC),** Sheraton Hotel, New Orleans, LA. Contact: Effie Cooper, STC, One Rockefeller Plaza, Suite 1410, New York, NY 10020, (212) 582-3909.

September 29-October 1: **9th Annual Electrical Overstress/Electrostatic Discharge Symposium,** The Peabody, Orlando, FL. Contact: Michael Martin, 3M/Static Control Systems, 2111 W. Braker Lane, Bldg.501, PO Box 2963, Austin, TX 78769, (512) 834-3117.

October 22-23: **19th Annual North American Power Symposium,** University of Alberta, Edmonton, Canada. Contact: Dr. D.O. Koval, Dept. of Electrical Engineering, University of Alberta, Edmonton, Alberta T6G 2G7, Canada, (403) 432-2481.

November 11-12: **International Monotech'87 Conference on Electrotechnologies,** Montreal, Quebec, Canada. Contact: J.P. Cristel, Canadian Committee on Electrotechnologies, 1 Westmount Sq. (525), Montreal, Quebec H3Z 2P9, Canada, (514) 931-5921.

November 13-16: **9th Annual Conference of the IEEE Engineering in Medicine and Biology Society,** Park Plaza Hotel, Boston, MA. Contact: Dr. Ronald Newbower, Dept. of Biomedical Engineering, Massachusetts General Hospital, Boston, MA 02114, (617) 726-1676.

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UPDATES

BIOLOGICAL EFFECTS

Special Issue... The March issue of the *IEEE Engineering in Medicine and Biology Magazine* is devoted to the "Effects of EM Radiation." Among the areas covered in the ten papers are: cellular effects, by Dr. Steve Cleary; teratogenic effects, by Dr. Joe Lary; immunological effects, by Dr. Ralph Smialowicz; and the 1982 ANSI safety standard, by Dr. Om Gandhi, who highlights the potential hazards due to shocks and burns below 30 MHz and heating by millimeter waves. Single copies are available for $3.00 for IEEE members and $14.00 for others from IEEE, 445 Hoes Lane, Piscataway, NJ 08854, (201) 981-0060.

COMPATIBILITY & INTERFERENCE

Power Lines and PCs...60 Hz magnetic fields can cause displacements of the electron beam in a CRT, resulting in the distortion of characters on the computer display, according to a study of "Interference from 60 Hz Electric and Magnetic Fields on Personal Computers" by Rod Baishiki of PG&E in San Francisco, CA, and Dr. Don Deno of GE in Lenox, MA. The type of distortion depends on the orientation of the field relative to the monitor; the operator's sensitivity to the distortion is related to the vertical scanning frequency. The distortions can be eliminated by placing Mu metal shielding around the monitor. Baishiki and Deno also address the risks associated with electric fields – spark discharges. Their paper appears in the April issue of the *IEEE Transactions on Power Delivery.*

EMI from HVDC Stations...A research team from the International Engineering Co. in San Francisco, CA, and Ohio State University in Columbus has developed a computer program that can calculate the voltages and currents associated with 5-500 kHz noise in HVDC converter stations. Predictions conformed "reasonably well" with the measured values. This study is an extension of earlier work by the same group (see *MWN*, May 1985); both were funded by EPRI. *Radio Interference from HVDC Converter Stations: Modeling and Characterization* (No. EL-4956), December 1986, is available, prepaid, for $32.50 from the Research Reports Center, PO Box 50490, Palo Alto, CA 94303, (415) 965-4081. Overseas orders cost $65.00.

Lightning Downs Rocket... An Atlas-Centaur rocket carrying a U.S. Air Force communications satellite had to be destroyed on March 26 when it veered out of control a minute after it was launched from Cape Canaveral, FL. Although an investigation is far from complete, NASA officials believe that lightning was responsible; one investigator said that the storm's electromagnetic field may have been the cause. Early speculation that explosive bolts on the rocket's nose cone may have been detonated by the lightning was dismissed when the bolts were later recovered intact.

GOVERNMENT

FCC Modifies RF/MW Rules... The FCC has issued two refinements to its regulations for RF/MW radiation-emitting devices. In February, the commission issued a final rule exempting land-mobile, cellular radio and microwave point-to-point communications, as well as most auxiliary broadcast services, from having to prepare environmental assessments under the National Environmental Policy Act (NEPA). These exemptions were first proposed in 1985 at the same time that the commission issued its NEPA rules (see *MWN*, April 1985). Experimental and commercial broadcast stations and satellite communication stations must still comply with the environmental rules. The FCC has also issued a proposal to protect against potentially hazardous RF/MW radiation from shipboard radars and satellite uplinks. If adopted, the rules will require manufacturers of marine radars and uplinks to provide guidelines for the safe installation and operation of their equipment because, according to the FCC, "the possibility does exist for significant [radiation] exposure." The commission notes that the proposed rules "would be administratively more feasible than requiring separate environmental analysis of every application for a ship-earth or radar station." At press time, the final and proposed rules were scheduled to be published in the *Federal Register* in mid-April and at the end of April, respectively. Still pending before the FCC is a petition filed by the National Association of Broadcasters asking for federal preemption of state and local RF/MW radiation safety standards (see *MWN*, May/June 1986). For more information, contact the FCC's Bob Cleveland, Office of Engineering and Technology, FCC, 1919 M St., NW, Washington, DC 20554, (202) 653-8169.

MEETINGS

Magnetotherapy in Hungary... The *2nd Hungarian Symposium on Magnetotherapy* will be held May 16-17 in Szekesfehervar. Many fascinating presentations are scheduled. Among them: Dr. Yu. Kholodov and coworkers from the Institute of Higher Nervous Activity and Neurophysiology in Moscow, U.S.S.R., on "Nervous System Reactions to Magnetic Fields"; Dr. A. Prusinski and coworkers from the Medical Academy of Lodz, Poland, on "PEMFs in the Therapy of Headaches"; Drs. Z. L. Schubert and P. Kapp of the University of Veterinary Sciences in Budapest, Hungary, on "The Effect of Long-Term PEMFs on Dog Embryos and Young Animals"; and Drs. E.S. Vainshtein and L.V.

Zobina of the Helmholtz Research Institute of Ophthalmology in Moscow, on "PEMFs for Eye Diseases." For more information, contact: Dr. A. Guseo, H-8001 Szekesfehervar, Seregelysei u.3, Hungary.

Harmonic Conference... The proceedings of the *2nd International Conference on Harmonics in Power Systems*, held October 6-8 in Winnipeg, Manitoba, Canada, have been reprinted, and a limited number of copies are still available for $100.00 Canadian or $80.00 U.S. each. To order your copy, write to Manitoba HVDC Research Center, 400-1619 Pembina Highway, Winnipeg, Manitoba R3T 2G5, Canada.

PEOPLE

Edwin Carstensen, professor of electrical engineering and biophysics at the University of Rochester, NY, has been elected to the National Academy of Engineering. The academy cited his contributions to "the understanding of ultrasonic and dielectric properties of biological media and the biological effects of ultrasound and ELF electric fields."

Charles Miller has retired as the chief of the Electromagnetic Fields Division at the National Bureau of Standards in Boulder, CO. Dr. **Ramon Baird** has taken over as the acting chief of the division.

The two leading manufacturers of hyperthermia equipment continued their feud in March – this time, over executive talent. **Victor Vaguine** resigned as executive vice-president of Clini-Therm Corp. and replaced **James Skinner** as president and CEO of BSD Medical Corp. It is not clear whether Skinner resigned or was forced out. The two companies will be in court later this year over the patent infringement suits each company filed against the other (see *MWN*, March/April 1986).

STANDARDS

IEC and CISPR... The IEC recently published *Radio-frequency Cables. Part 1: General Requirements and Measuring Methods* (No.96-1), $47.00, and *Methods of Measurement for Radio Equipment Used in Satellite Earth Stations. Part 1: Measurements Common to Sub-Systems and Combinations of Sub-Systems. Section 4: Measurements in the Baseband* (No.510-1-4), $27.00. Both are available, prepaid, from the American National Standards Institute's (ANSI) Sales Dept., 1430 Broadway, New York, NY 10018, (212) 642-4900; add $5.00 for postage and handling for one publication, or $6.00 for both....CISPR has issued *CISPR/G(Central Office)2, Amendments to CISPR Publication 22: Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment* as a six-month draft rule. It is available for $9.00, prepaid, from ANSI.

VDTs

VDT Radiation Meters... It is now much easier to measure the electromagnetic fields associated with VDTs; two companies are marketing VDT radiation meters. Dr. Hari Sharma of the University of Waterloo in Ontario, Canada, has designed the EMF 1, which can measure both ELF and VLF fields. It has been evaluated by Professor S.N. Karla, also of the University of Waterloo. The meter costs $600.00 (U.S.), plus shipping and handling; allow eight weeks for delivery. EKM Associates, Inc., is the exclusive distributor for Sharma's meter in the U.S. and Canada. Only a limited number of the meters are now available; more will be produced if there is sufficient demand. Contact: Ms. Sigrid DiBella, EKM Associates, Inc., 342 Consumers Rd., Willowdale, Ontario M2J 1P8, Canada, (416) 497-0605. Holaday Industries, well-known for its line of RF/MW measurement units, is also planning to introduce a VDT meter in the next few months. The meter will have both magnetic and electric field probes, in addition to a liquid crystal display. It will pick up signals in the 10-100 kHz frequency range. Holaday expects that its meter, Model HI-3600, will be available for delivery in July for less than $1,000. For more information, contact Holaday Industries, 14825 Martin Dr., Eden Prairie, MN 55344, (612) 934-4920.

ETC...

An Idea Whose Time Has *Not* Come...The design of consumer products has entered a new phase with the advent of "product semantics," the concept that products should be designed to communicate visually. Examples include hair dryers with wavy shapes and tea kettles with birds at their spouts for whistling. According to *The Wall Street Journal* (March 26), Philips Industries developed a microwave oven in the shape of a fondue pot, for use at the dining room table. The design looked more like a nuclear power plant, however, and was shelved.

Look Ma, No Laser... Last Christmas, among the hottest new toys were laser guns, including Mattel's Neutra-Laser, Remco's XSL Phaser Command and Worlds of Wonder's Lazer Tag. Researchers at the Electro-Optics Branch of the FDA's Center for Devices and Radiological Health began to wonder whether the guns' radiation could harm children's eyes and tested the models made by six different manufacturers. They quickly discovered that none of them use a laser; instead, the beams are simulated by infrared-LEDs, flashtubes or even light bulbs. The center concluded that the tested products "do not pose any known biological hazard."

On April 8, the House Armed Services Committee approved an amendment to the 1988 Defense Authorization Act, offered by U.S. Congressmen Roy Dyson, a Maryland Democrat, and Herbert Bateman, a Virginia Republican, which would bar the Navy from testing EMPRESS II on Chesapeake Bay during fiscal year 1988. Last year Congress approved a similar amendment, sponsored by Dyson, that stops all EMP testing on the bay during the current fiscal year.

Dyson has argued that it makes no sense for the federal government to spend millions of dollars to clean up the bay and, at the same time, support a project that might have the opposite effect.

The Navy selected Chesapeake Bay as its preferred site on which to test whether its ships can withstand the EMP of a nuclear blast. EMPRESS II can produce pulsed electric fields of 50 kV/m at 100 yards at 30-minute intervals. The simulator, which would be floated on a barge near Bloodsworth Island, would replace EMPRESS I, a smaller simulator based at the Patuxent Naval Air Test Center on the shore of the bay.

The Chesapeake Bay choice has long stirred strong environmental opposition. Maryland officials, who are already on record as opposing the Navy's plan, contend that operation of EMPRESS II might shut down the Port of Baltimore for 20 days per year (see *MWN*, January/February 1987). According to the SDEIS, the Navy would operate EMPRESS II for as many as 60 days per year – 20 days on Chesapeake Bay and 40 days at sea.

In comments on the Navy's Supplemental Draft Environmental Impact Statement (SDEIS), the federal Environmental Protection Agency (EPA) reaffirmed its previous opposition to siting EMPRESS II on the bay. In a February 27 letter, John Pomponio, the chief of the environmental impact and marine policy branch at EPA's Region III office in Philadelphia, PA, wrote that, "Based upon the inconclusive results of the short-term impact studies [contained in the SDEIS] we do not agree with the SDEIS that EMPRESS II will cause no impact to organisms of the Chesapeake Bay."

EPA was particularly critical of the Navy's interpretations of the short-term studies in the SDEIS. "The statistics presented in the report do not clearly support the conclusions that were drawn," the letter stated. The agency cited numerous scientific shortcomings; it chided the Navy for the incompleteness of the experiments on fish and birds.

Noting that the Navy had acknowledged the studies' shortcomings, EPA concluded that, "Because of the Navy's doubts as well as our own we suggest that [EMPRESS II] not be deployed in the Chesapeake Bay."

Similarly, a top-ranking Virginia environmental official argued that locating the simulator on the bay "would pose unacceptable environmental, social and economic risks which we are not prepared to take."

The official, Keith J. Buttleman, administrator of Virginia's Council on the Environment, also suggested that the Navy has not handled the siting process fairly. "The decision process is a source of much concern and leaves us with the impression that decision makers are not amenable to dispassionate investigation of the matters that should be known before such a momentous decision is made," he wrote in a February 13 letter to the Navy.

Elected officials from Maryland are adding to the pressure on the Navy. On March 24, the Maryland House of Delegates unanimously approved Joint Resolution 42, sponsored by Samuel Q. Johnson, III, which would stop the Navy from siting EMPRESS II on the bay. The House of Delegates passed a similar resolution two years ago (see *MWN*, April 1985). The State Senate held a hearing on the resolution on April 3 and is expected to pass it, according to a legislative aide.

Two key EMPRESS II staffers have left or will leave the Navy in the near future. Captain B.L. Powers, manager of the Navy's Theater Nuclear Warfare Program, which includes EMPRESS II, will soon retire. Lt. Commander A. Gritzke, the project manager for EMPRESS II, retired on April 1.

Environmental Assessment of DOD's EMP Research Sought

Two environmental groups have asked a federal court to block the U.S. Air Force, Army and Navy from using all electromagnetic pulse (EMP) simulators until a "complete and thorough programmatic" environmental impact statement (EIS) has been prepared.

On March 9, the Foundation on Economic Trends, in Washington, DC, and the Potomac River Association, in Valley Lee, MD, sued the Department of Defense (DOD) in the U.S. District Court for the District of Columbia, arguing that EMP simulators "pose a grave potential threat to the environment and public health."

The Pentagon has refused comment on the suit.

In recent years, Jeremy Rifkin, the president of the foundation, has filed and won a number of lawsuits seeking EISs on the environmental risks associated with the commercialization of recombinant DNA technology. In February, a federal judge sided with Rifkin and ordered DOD to prepare a programmatic EIS on its biological warfare research program.

Rifkin's EMP lawsuit is the latest indication of a growing public awareness of EMP technology. Last year, two Washington-area individuals petitioned the Federal Communications Commission (FCC) to open a notice of inquiry on the threat of EMPs to civilian communication systems. Their petition was rejected by the FCC, but in January, they asked the commission to reconsider (see *MWN*, September/October 1986 and January/February 1987).

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Upcoming Meetings

Henhouse Project: Weak PMFs Cause Chick Abnormalities

The combined results of studies from six labs in four countries indicate that extremely weak pulsed magnetic fields (PMFs) can have a detrimental effect on the development of chick embryos. In a paper to be presented at the *Annual Meeting of the Bioelectromagnetics Society* (BEMS) in June, the international team will report that five of the labs found increases in the number of abnormalities among exposed embryos. Although the increase was statistically significant in only two of the labs, the pooled data from all six labs were, as a whole, highly significant.

The "Henhouse" project was prompted by a number of reports – beginning in 1982 – from Dr. Jocelyne Leal at the Ramón y Cajal Hospital in Madrid, Spain, which showed that very weak PMFs could have profound and consistent effects on the developing chick embryo (see *MWN*, March and November 1983 and December 1984). A number of later attempts to repeat the findings met with mixed success (see *MWN*, June 1984 and May/June 1986), prompting the U.S. Office of Naval Research (ONR) to support an international effort to either confirm or refute the Leal findings (see *MWN*, January/February 1986).

The new results (see the abstract of the BEMS paper on p.14) should help convince skeptics that magnetic fields can be biologically active at very low levels. As Jack Monahan of the Food and Drug Administration in Rockville, MD – one of the six Henhouse researchers – explained in a

(continued on p.14)

Revision of ANSI RF/MW Safety Standard Stalled

Work on the revision of the American National Standards Institute (ANSI) standard for human exposures to radiofrequency and microwave (RF/MW) radiation is at a standstill. Resignations, worries over liability, lack of funds and an extraordinarily cumbersome review procedure have halted progress towards revising the 1982 standard, which – in the absence of federal rules – has become the most influential RF/MW health guide in the U.S.

Dr. Kristian Storm, the chairman of the ANSI-accredited subcommittee IV of Committee C95 on Non-Ionizing Radiation Hazards, resigned in December. Soon afterward, Professor Saul Rosenthal announced that he would step down as the chairman of the C95 committee. In addition, the U.S. Navy, which has served as co-secretariat of the committee with the Institute of Electrical and Electronics Engineers (IEEE), wants to give up its long-standing support of C95.

(continued on p.15)

« Power Line Talk »

Dr. **David Carpenter** was at the center of a roundtable discussion on EMF risks with utility staffers at the February meeting of the IEEE **Power Engineering Society** in New York City. He fielded questions such as, "We are getting a lot of pressure to fix something, but do we know what to fix?" and "If the EMF risk is so much smaller than that of cancer from smoking, how much attention should we place on it?" and "How does the risk from power lines compare to those from wood stoves or from radon?" On the one hand, he replied, "This is a relatively minor risk," but on the other hand, he added, "Because no one has paid much attention to it, we don't know how difficult it is to correct. Perhaps we could save many children's lives at little cost." He estimated that, if the EMF-cancer link is confirmed, at least 1,000 cases of childhood cancer could be attributed to magnetic fields. In a commentary appearing in *Health & Environment Digest*, a new newsletter published in Minneapolis, MN, Carpenter derives this estimate and elaborates on the often-quoted figures from the New York State Power Lines Project (PLP), that magnetic fields from power lines could be responsible for 10-15% of childhood cancers: "The estimate of 10-15%, however, is restricted to cancers due to the distribution system at the residence, and does not consider exposure from appliances and other sources....My guess, assuming a linear dose-response relationship, is that the contribution [of magnetic fields to cancer] could be greater by a factor of two." After a quick calculation and a few assumptions about exposed workers, he writes, "The total 'body count' is on the order of 2,000 cases of childhood cancer and 4,000 cases of adult cancer per year." We asked Carpenter, who is with the NY Department of Health (he previously served as the executive secretary of the PLP), about this doubling of the estimated risk for children. "Given all the considerations and caveats of the calculations, that's the logical implication of our report," he replied.

«« »»

Australia's Victoria State Electricity Commission ran the ad shown on the above left in the Melbourne *Sun* on March 8 to pressure the approval of a 220 kV line between Brunswick and Richmond (see *MWN*, July/August 1986). The text below the headlines reads: "Just one existing power line keeps the business heart of Melbourne running. If anything should happen to that line, much of the city area and thousands of homes in the eastern suburbs would be powerless. Every day about 350,000 people depend on that one line. No other city of our size in the world has such a threat hanging over it. We urgently need the new power line to safeguard eastern Melbourne from the possibility of a total electrical blackout. Every day that passes brings the nightmare closer." Nevertheless, opposition kept growing and, in late March, the state government canceled the line. A union official in Victoria told *Microwave News* that, "It is most unlikely that any further overhead system will ever be built in urban areas in Australia."



BRUNSWICK TO RICHMOND POWER LINE

The lights go out. The lifts stop. The traffic halts. The doors jam.

Melbourne is closer to this nightmare than any big city in the world.

Just one existing power line keeps the business heart of Melbourne running. If anything should happen to that line, much of the city area and thousands of homes in the Eastern suburbs would be powerless.

Every day about 350,000 people depend on that one line. No other city of our size in the world has such a threat hanging over it.

We urgently need the new power line to safeguard Eastern Melbourne from the possibility of a total electrical blackout.

Every day that passes brings the nightmare closer.

Today

NEWSPAPER OF THE YEAR

NEW CLUE TO PYLON CANCER

Tory price to get Ford back

As the headline at right, above, from the March 19 English tabloid *Today* shows, the Savitz study has arrived in the U.K. The news stories were prompted by a BBC documentary and by a Central Electricity Generating Board announcement (see p.4). On March 28, Cecil Parkinson, Secretary of State for Energy, condemned the documentary in Parliament, according to a report by *The Independent:* "I believe [it] was essentially a scare-mongering program."

«« »»

So much has been written about Dr. **David Savitz** and coworkers' epidemiological study that it is easy to forget that it has not yet been officially published: It is scheduled to appear in the July issue of the *American Journal of Epidemiology*. The companion New York State study on adults by the **Battelle** group will be in the same issue. We had heard that the journal had put the papers on a fast track, given the huge interest in the results, but a staffer at the journal refused to comment, saying that she did not want to single out any articles as more or less important than any others. The engineers who collaborated with the epidemiologists are also publishing papers on their extensive measurement surveys. The results of Dr. **Bill Kaune**'s Battelle group were published late last year in *Bioelectromagnetics* (*8*, pp.315-335, 1987). Professors **Frank Barnes** and **Howard Wachtel** of the University of Colorado in Boulder have submitted their manuscript to the same journal – a publication date has not yet been set. Kaune, who left Battelle to go to the National Bureau of Standards (NBS), is returning to the ELF business and will join **Mike Silva** at **Enertech Consultants**, in Campbell, CA, in early

April. At the NBS, he was with the Electromagnetic Fields Division, working on broadband microwave metrology. Kaune is a member of EPRI's EMF exposure assessment advisory subcommittee.

«« »»

There was a face-off between Drs. **Jerry Phillips** of the Cancer Therapy & Research Foundation in San Antonio, TX, and **H.B. Graves**, chief scientist at Crowell & Moring, a law firm in Washington, DC, on March 17 at the **American Public Power Association** workshop in New Orleans. After reviewing the latest bioeffects studies, Phillips asked, "How do we determine whether the problem is a big one or...a small one?" He maintained that science will yield the answers because more and more researchers are becoming interested in bioelectromagnetics. Graves countered Phillips's arguments, observing that, "Some of the [EMF] effects are there and some of them fade out on closer examination." He concluded that, "The main science commissions...have [unanimously] said there's no persuasive scientific evidence of adverse health impacts."

«« »»

Over the last five years, we have featured extensive coverage of the state of **Florida**'s efforts to write rules governing the siting of transmission lines. As we reported at the end of last year, just when the state Department of Environmental Regulation (DER) was about to propose EMF standards, the state court of appeals issued a decision which, contrary to previous rulings, found that power lines could be approved without DER action. Now, according to DER's Buck Oven, the rule-making job has been passed on to the state **Environmental Regulation Commission,** chaired by Robert Mandell, a developer/attorney from Orlando. Following a briefing at the commission's February 17 meeting, Mandell asked to hear from a number of expert witnesses – many of whom had already testified before the state EMF advisory panel. The next commission meeting is April 14-15. Meanwhile, the decision on **Florida Power Corp.**'s long-pending 500 kV line near Tampa is up to the governor and his cabinet. A decision was expected in March but has now been put off until April 26.

«« »»

Add Maryland to the list of states facing a power line dispute. The **Maryland People's Counsel** (MPC), which represents the interests of residential electricity users, is seeking a consultant to guide the office through **hearings on a 500 kV power line** proposed by the Potomac Electric Power Co. (PEPCO). The 10-mile line would complete a loop around Washington, DC. According to MPC's Kirsten Burger, the agency is looking for someone with technical expertise to provide testimony on the effects of power line magnetic fields. On January 22, a local zoning board approved PEPCO's line – provided that "the Public Service Commission finds that [it] will not endanger the health and safety of residents in the area." The **Brinkwood Community Association,** a citizens group opposing the line, requested the hearings and, although no official date has been set, they will probably take place this summer.

«« »»

In our March/April 1987 issue we outlined the then-forthcoming **World Health Organization/International Radiation Protection Association** (WHO/IRPA) Environmental Health Criteria (No.69) on **static and time-varying magnetic fields** (see also p.9). The printing was delayed and it has only recently appeared. In the U.S. you can order a copy for $9.60 from WHO Publications Center USA, 49 Sheridan Ave., Albany, NY 12210. Most other countries also have their own retail outlets for WHO reports.

«« »»

"Power Lines and Cancer?" will be the subject of the opening session of the **Electromagnetic Energy Policy Alliance**'s (EEPA) annual meeting, ***Full Spectrum Electrophobia: DC to Daylight.*** Among the scheduled speakers will be Drs. John Bergeron, David Carpenter, Edwin Carstensen and Philip Cole. For more information on the meeting, which will be held in Alexandria, VA, April 20-22, contact: EEPA Executive Director Richard Ekfelt, (202) 452-1070.

«« »»

Articles on **ELF health risks** continue to proliferate in broad-based and in specialized publications. For instance, the ***Journal of the American Medical Association*** ran an item, "Do Power Line-Generated EMFs Have Any Association with Certain Disorders?" in its February 26 edition. And the February 1 issue of ***Business Insurance*** considers the potential liability problem for electrical utilities and appliance manufacturers.

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100 Hz Sine Waves Transform Cells

A team of researchers at the Naval Medical Research Institute (NMRI) in Bethesda, MD, has reported that a 100 Hz sinusoidal electromagnetic field (EMF) can malignantly transform cells. If confirmed, the finding will add a new dimension to the ongoing debate on the cancer risk associated with exposure to extremely low frequency (ELF) fields.

In a paper presented at the *32nd Annual Meeting of the Biophysical Society* on March 2 in Phoenix, AZ, Dr. Abe Parola described how chick embryo fibroblasts exposed to a 7 G 100 Hz magnetic field for 24 hours were transformed, as determined by three independent experimental techniques. Parola's abstract explains that the effect was magnetic and not thermal.

Parola, who is with Ben-Gurion University of the Negev in Beer-Sheva, Israel, has been doing research at the NMRI for the last two years, using the same exposure system as the one used by Dr. Abe Liboff when he was at NMRI and whose results were reported in *Science* (*223*, pp.818-820, 1984). "It's one of the best ELF exposure systems around," Liboff told *Microwave News* from his office at Oakland University in Rochester, MI. He explained that the system's large coils guarantee uniform magnetic fields in the incubator.

Parola is scheduled to present these results at the *Annual Meeting of the Bioelectromagnetics Society*, to be held June 19-24 in Stamford, CT. He returned to Israel immediately after the Phoenix conference and could not be reached for comment. NMRI's Dr. Lutz Kiesow, a coauthor of the paper, did not return phone calls requesting comment.

Liboff said that, although it was not mentioned in the abstract, Parola had told him in Phoenix that he had also observed transformation with an exposure of 100 mG.

Up to now, researchers have assumed that EMFs can *promote* the growth of cancer cells but not *transform* normal cells into a cancerous state. Parola is claiming that ELF fields can transform cells. If his experiments are replicated, they will undoubtedly magnify the potential health threat associated with exposure to ELF fields.

Not surprisingly, scientists who had read the abstract were intrigued, though a little skeptical pending the release of more information. For instance, Dr. Chris Cain of the VA Hospital in Loma Linda, CA, said that he is "very interested" in the paper but, for the moment, is withholding judgment until he can find out details about Parola's protocol – e.g., how long after exposure the cells were assayed.

Similarly, Dr. Jerry Phillips of the Cancer Therapy and Research Foundation in San Antonio, TX, told *Microwave News* that the paper is "of extreme interest and of obvious importance." He added that, "It is good as far as it goes," but cautioned that to document transformation, one must show: (1) loss of growth regulation; (2) loss of contact inhibition; and (3) ability to establish a tumor in a host. Parola has not yet reported this, he said.

U.K.'s CEGB Steps Up Power Line Health Effects Research

The Central Electricity Generating Board (CEGB), which is responsible for the generation, transmission and distribution of electric power in the U.K., is adding £500,000 to its ongoing research effort on the health risks associated with electric and magnetic fields.

The board's major new initiative will be a study by "an independent epidemiological group" of all new diagnosed childhood cancer cases in England and Wales. The children's past exposures to magnetic fields will be estimated.

Other elements of the CEGB research plan include an assessment of both the home and work field exposures of its staff, using personal dosimeters, and an independent basic research program. The new projects will double – to £1 million – the board's research budget on electromagnetic fields in the coming year, according to Dr. Peter Chester, the CEGB's director of environmental affairs.

The board is currently sponsoring health studies at the University of Leeds, the University of Manchester and the county health departments in Yorkshire and Lancashire. Dr. Robin Cox, the CEGB's chief medical officer, said that preliminary findings of an ongoing study on power lines and childhood cancer showed no association. The results of a companion adult leukemia study are expected next year.

Cox added that none of the board's studies have found any ill effects due to power lines: "On the evidence to date,

NCI Study on Childhood Cancer Will Include EMFs

The National Cancer Institute (NCI) is planning a major study on the etiology of childhood cancer, to include an investigation of the role of a number of factors including electromagnetic fields (EMFs).

A spokeswoman for the institute told *Microwave News* that an advisory group will be formed to design the study protocol. "Magnetic fields will be one of the major components of the study," she said, adding that nothing else is definite at this time. Once the protocol is approved by the NCI Division of Cancer Etiology's Board of Scientific Counselors, a request for proposals will be issued.

According to a report in the March 11 *Cancer Letter*, the multi-center case control study would cost a total of $2.8 million; the first year's expenses would be $810,000. The children's residential exposures and the parents' occupational exposures would be estimated, along with the mothers' use of electrically-heated water beds and electric blankets during pregnancy.

no significant health risk to the public has been demonstrated from these fields." He said that the Savitz epidemiological study had shown "a weak association."

The CEGB announcement was released on March 17, a few days before the British Broadcasting Corp. (BBC) aired an investigative report on the health risks associated with power lines (see p.2).

For more information, contact: Dept. of Information and Public Affairs, CEGB, Sudbury House, 15 Newgate St., London EC1A 7AU, U.K., (01) 634-5111.

NY PSC Supports 1.6 kV/m and 100 mG Limits at ROW

The New York Public Service Commission (PSC) will preserve its 1978 interim 1.6 kV/m electric field standard along the edge of power line rights-of-way (ROWs) and has endorsed the development of a companion magnetic field standard. In addition, the PSC has backed a study on childhood cancer and electromagnetic fields (EMFs) in New York state, as well as other types of power line research.

On February 24, the PSC approved these and other recommendations made in its January 11 task force report, which reviewed the findings of the NY Power Lines Project (PLP), issued last July (see *MWN*, July/August 1987).

With respect to magnetic fields, the task force concluded that the PLP's research findings "revealed no evidence that magnetic fields pose a health hazard." Dr. Daniel Driscoll, chairman of the task force, told *Microwave News* that the Savitz epidemiological study in particular showed "no causal link" between magnetic fields and childhood cancer.

Driscoll noted that, "The research gave [the task force] cause for concern" but did not call for a course of action that would "disrupt industry around the country."

In a telephone interview, Dr. David Carpenter of the NY Department of Health (DOH), who serves as executive secretary of the PLP, said that he does not agree with some of the task force's language. "To a degree, the PSC's response is very conservative, but probably not inappropriate," given the concern over economic disruptions.

The task force suggested a magnetic field limit of 100 mG at the edge of the ROWs and recommended that, "If a magnetic field limit is adopted, it should be made clear that magnetic fields have not been shown to be hazardous and that the purpose of the limit is to ensure that exposures...would be no greater than those which society has implicitly accepted for the 345 kV lines operating for many years throughout New York state."

This is the same logic as that used by the PSC in 1978 for its electric field standard. The task force noted that there still is "not a more reasonable or precise method" for establishing an electric field limit and argued, therefore, that further research into the biological effects of EMFs produced by power lines is needed before a final safety determination can be made.

The task force cautioned that both the electric and magnetic field standards should be considered "interim" until further notice.

Carpenter anticipates that the 100 mG level will be revised downward in the future.

The PSC also approved the task force's recommendation to continue the suspension of 2% matching grants which promoted outdoor recreational and educational uses of power line ROWs. In addition, the PSC instructed the NY Power Authority (NYPA) to continue to bar residential development within 175 feet of the center of a 765 kV power line.

The task force made a number of recommendations for future research:

- The Department of Public Service (DPS), the PSC's parent agency, should support research on power line EMF effects – specifically, an epidemiological study of childhood cancer and magnetic field exposures in New York state. According to Driscoll, sources of funding have not yet been identified.
- A PSC staff group should be formed to monitor these studies; the group would be charged with periodically reviewing the interim field limitations and analyzing incoming data on EMFs and human health.
- The DPS should join with the NY DOH in encouraging the federal government to undertake "relevant" research. The DOH has already contacted the National Cancer Institute, the Department of Health and Human Services, the National Academy of Sciences and the National Science Foundation to urge further investigations.
- The DPS and the PSC should encourage additional multistate research mediated by a nonpartisan federal agency, such as the National Association of Regulatory Utility Commissioners.
- NY state utilities should implement a program of surveying and measuring EMF exposures in the state – including field measurements of overhead and underground transmission and distribution lines; the utilities should also investigate alternative means of power use and delivery to reduce EMF exposures.

The NY PLP was initiated in 1980 in response to protests against the building of NYPA's 765 kV transmission line. State utilities agreed to fund a $5 million research program on possible health hazards associated with power line-produced EMFs in exchange for a PSC guarantee exempting them from future payments in support of "any other program on the same subject in pending or future transmission line siting proceedings." According to Driscoll, by limiting its recommendations for future utility-supported studies to technical – rather than biological – research, the task force continues to honor this agreement.

For more information on the PSC task force recommendations, contact: Dr. Daniel Driscoll, Office of Energy Conservation & Environmental Planning, PSC, Three Empire State Plaza, Albany, NY 12223, (518) 474-5368. To receive future

mailings on the *Interim Transmission Line Magnetic Field Standard Proceedings*, submit a written request to John Kelliher, secretary, DPS, at the same address.

Budgets for EMF Research Are Growing at EPRI

The Electric Power Research Institute (EPRI) plans to spend $6 million for research on extremely low frequency (ELF) electric and magnetic fields (EMFs) in 1989 – more than triple its 1985 budget of $1.7 million. EPRI has budgeted an additional $6 million for 1990.

There has been no comparable growth at the Department of Energy, the other major source of funds for ELF field effects research. The Environmental Protection Agency and the U.S. Navy have eliminated most of their work on ELF bioeffects – except for the ecological studies near the Navy's Project ELF transmitter.

EPRI, in contrast, has increased its ELF budget dramatically in the past four years, as shown in the table below:

1985 — $1.7 million
1986 — $1.7 million
1987 — $2.7 million
1988 — $4.7 million
1989 — $6.0 million
1990 — $6.0 million

(As of November 1987, EPRI had allocated only $3.2 million for research on EMFs in 1988.)

These budget statistics appear in EPRI's *Research & Development Program Plan 1988-1990*, dated January 1988. According to the plan, EPRI's goals for the next three years are as follows:

- By 1989, provide measurement methods and equipment to assess exposure of workers and the public;
- By 1990, provide data, analyses and methods to identify potential health effects, significant levels of exposure and mechanisms of biological action that may be associated with electric and magnetic fields;
- By 1990, provide data to characterize the magnitude, range and time variation of magnetic fields, pinpoint field sources and relate field characteristics to these sources;
- By 1991, provide production-grade software that predicts magnetic fields;
- By 1991, transfer exposure data base to utilities and publish results of comprehensive exposure assessment of workers and the public.

Recently, EPRI announced the recipients of its basic science grants:

1) "Ultrastructure of Candidate Magnetic Sense Organs in Fish," Dr. Joseph Kirschvink, California Institute of Technology.

2) "Response of Drosophila and Human Cells to ELF EMFs," Drs. Reba Goodman and Ann Henderson, Columbia University and Hunter College, NY.

3) "ELF and Cancer Promotion – Studies on Cell Cultures and Mammary Tumors/Endocrine System in Rats," Drs. Shin Tsu Lu and Sol Michaelson, University of Rochester, NY.

The recipients were selected from 16 who submitted proposals. The contract periods are anticipated to be three years.

According to EPRI's Dr. Charles Rafferty, the precise terms of the contracts are in "the last stages of negotiation." Specific details on budgets and work to be performed were unavailable at press time.

For a copy of the *EPRI Research and Development Program Plan 1988-1990*, send $10.00 ($20.00 outside the U.S.) to: EPRI, Communications Services, PO Box 10412, Palo Alto, CA 94303, (415) 934-4212.

IARC Meeting on ELF Fields and Cancer

The International Agency for Research on Cancer (IARC), a part of the World Health Organization, is planning a May 2-3 meeting in Lyon, France, on extremely low frequency (ELF) *Electromagnetic Fields and Cancer Risk.*

The workshop will focus on the current design of ELF epidemiological studies. In addition, it will explore the possibility of standardizing experimental protocols and measurement indices and coordinating the results of future projects.

Among those scheduled to discuss studies on ELF exposure assessment and occupational and residential risks are: Dr. Anders Ahlbom, National Institute of Environmental Medicine, Sweden; Drs. Joseph Bowman and David Garabrant, University of Southern California, U.S.; Dr. Jean-Paul Cabane, Electricité de France; Dr. Bengt Knave, Swedish National Institute of Occupational Health; Dr. Genevieve Matanoski, Johns Hopkins University, U.S.; Dr. Tony McMichael, University of Adelaide, Australia; Dr. Neil Pearce, National Health Statistics Center, New Zealand; Dr. David Savitz, University of North Carolina School of Public Health, U.S.; Dr. Stanley Sussman, Electric Power Research Institute, U.S.; and Dr. Gilles Thériault, McGill University, Canada.

IARC's Dr. Michel Coleman, who is organizing the workshop, hopes to assemble an IARC scientific publication that would provide an overall assessment of the cancer risk associated with exposures to ELF fields. For more information, contact: Dr. Michel Coleman, IARC, 150 Cours Albert-Thomas, 69372 Lyon Cedex 08, France.

HIGHLIGHTS

IRPA Shrugs Off VDT Radiation Health Risks

The International Radiation Protection Association (IRPA) discounts the radiation hazards associated with VDT work.

In a paper on "alleged" VDT radiation risks published in the February issue of *Health Physics*, IRPA's international non-ionizing radiation committee (INIRC) concludes that, "There are no health hazards associated with radiation or fields from [VDTs]," and that, "There is no scientific basis to justify shielding or radiation monitoring of [VDTs]." IRPA is a non-governmental group; many of its guidelines are issued jointly with the World Health Organization (WHO).

The references accompanying the IRPA paper are mostly from 1984. There are no citations to the Swedish radiation studies on pregnant mice (see *MWN*, March/April and May/June 1986 and July/August 1987) or to the Spanish chick egg experiments (see p.1), both of which have been at the center of an often-heated debate about pregnancy risks and VDT work.

IRPA's view differs from that of a WHO panel, which, in a 1986 paper (one of the two post-1984 references included in IRPA's review), discouraged VDT operators from working within one meter of the rear or sides of nearby terminals unless the units had been tested to check radiation emissions (see *MWN*, January/February 1987).

The IRPA/INIRC panel does suggest that more research on skin disorders and on the effects of low-frequency magnetic fields is in order because "a large number of people are involved" in VDT work.

Interestingly, Dr. Bengt Knave of the Swedish National Institute of Occupational Health, a member of the IRPA panel, presented a paper at a conference in August 1987 which contains the same conclusion – nearly word-for-word as that of the IRPA/INIRC (see *Social, Ergonomic and Stress Aspects of Work with Computers*, edited by G. Salvendy et al., pp.83-86, New York, NY: Elsevier, 1987). Knave was one of the principal organizers of the 1986 VDT conference, at which Swedish researchers presented the first data showing that VDT-type magnetic fields can have a deleterious effect on the developing mouse embryo.

In a paper published in 1985, panel member Dr. Michael Repacholi of the Royal Adelaide Hospital in South Australia reviewed the research from Dr. Jocelyne Leal's laboratory in Madrid, Spain (see *Australasian Physical and Engineering Sciences in Medicine*, *8*, pp.51-61, 1985, and *MWN*, May/June 1986). A third panel member, the F.R.G.'s Dr. J. Bernhardt, is on the advisory committee to the Ontario Hydro/IBM-sponsored team at the University of Toronto, which is in the process of conducting a major mouse embryo radiation study (see *MWN*, September/October 1987).

The other members of the IRPA/INIRC panel are: Drs. H. Jammet (chairman), France; B. Bosnjakovic, The Netherlands; P. Czerski, U.S.; M. Grandolfo, Italy; D. Harder, F.R.G.; J. Marshall, U.K.; D. Sliney, U.S.; and J. Stolwijk, U.S.

Microwaves in Moscow

The beaming of microwaves at the U.S. embassy in Moscow continues, albeit at relatively low levels.

In a March 3 statement issued in response to questions from Barton Reppert of the Associated Press (AP), the U.S. State Department acknowledged that radiation – "primarily" in the 9-11 GHz range, with some in the 5-6 GHz range – is being detected at the Moscow embassy chancery at "typical" power levels of 0.1 $\mu W/cm^2$ outside the building and 0.01 $\mu W/cm^2$ inside. The signals are "usually on for a couple of hours a day" and are "rarely detected during the nighttime hours," according to the statement.

The last report of microwaves from Moscow was in the fall of 1983 when power densities of 2 $\mu W/cm^2$ were measured outside the embassy. At that time, the U.S. ambassador, Arthur Hartman, denied that there was any health risk but filed a formal protest with the Soviet Foreign Ministry "as a matter of principle" (see *MWN*, December 1983).

It is not clear whether the Moscow signal was turned off after the 1983 incident or continued to be beamed at the embassy. State Department spokeswoman Phyllis Oakley told the AP that, "We have watched the situation carefully. We continue to watch it carefully. There have been low levels that we have detected, but these pose no risk."

The State Department refused to comment on the reason for the transmissions, "because any response would be speculation." Since the microwaves were first detected in 1953, many explanations have been offered, though none has won official backing. The possibilities include activating listening devices, manipulating employee behavior and convincing American scientists that non-ionizing radiation is biologically active. In 1976, protective screens were installed on the windows at the embassy.

In his 1978 epidemiological study of Moscow embassy employees, Professor Abraham Lilienfeld of Johns Hopkins University urged the State Department to continue to monitor the health of the embassy staff in Moscow and in other cities (see *MWN*, January 1981). The State Department told the AP that for the last six years, researchers at the Biostatistics Center of George Washington University in Washington, DC, have been maintaining a computerized Medical Information Management System for overseas employees.

The State Department also said that radiation measurements at the new office building complex, which has been at the center of a controversy over Soviet listening equipment, were very low – levels that "one would expect to find in any major city."

EMP Threat to Power Grid Questioned

The electromagnetic pulse (EMP) that would accompany a single high-altitude nuclear detonation would do minimal damage to the U.S. electrical power grid, according to Mario Rabinowitz of the Electric Power Research Institute (EPRI). In a recent report, he finds that previous predictions of severe grid damage were wrong primarily because estimates of peak pulse power were too high.

"As a result of present protection techniques, little or no [EMP] damage is expected for power plant equipment, substation equipment or power lines," Rabinowitz concludes, cautioning only that, "Although a solid case is made that the EMP cannot produce a national blackout, it has not been determined whether the EMP could produce a local regional blackout near the bomb burst."

Rabinowitz calculates the maximum electrical field generated by a high-altitude EMP to be approximately 12 kV/m, less than one-quarter of the previously suggested 50 kV/m maximum. This sizable difference is the result of his assumption that ionization from the detonation "severely attenuates" the pulse. The field strength – and the resulting harmful impact – would be approximately the same as that from a single stroke of lightning, he believes. (Rabinowitz excludes solid-state electronic circuits from his calculation.) Challenging other previous hypotheses, Rabinowitz reports that, "Concurrent multiple bomb bursts will not have an additive...effect, but will in fact interfere to produce less...than from a single burst."

This low-impact scenario is the latest twist in the long-standing EMP debate. During one of the last U.S. atmospheric nuclear tests, in 1962, EMP was suspected of disrupting power lines, opening circuit breakers, triggering burglar alarms and shutting off street lights in Hawaii. Rabinowitz challenges these reports, stating that these effects "cannot be substantiated."

Not surprisingly, Rabinowitz has attracted critics who challenge his methodology, his scientific reasoning and his understanding of EMP effects. Last fall, Rabinowitz published a paper – almost identical to the EPRI report – in the *IEEE Transactions on Power Delivery*, which was followed by 16 sets of comments.

Among the generally critical observations are those of Dr. Conrad Longmire of the Mission Research Corp. in Santa Barbara, CA, a leading EMP expert. Longmire finds that Rabinowitz's argument is "logically and technically flawed" and therefore "his conclusions are not justified." Similarly, Dr. Frederick Tesche of LuTech, Inc., in Dallas, TX, agrees, charging that Rabinowitz has oversimplified his analysis. Furthermore, Drs. B.W. McConnel and P.R. Barnes of the Oak Ridge National Laboratory in Oak Ridge, TN, state that, "[The] paper presents no experimental data to support the conclusions reached. The impact of EMP on power systems is simply not known at this time."

In his detailed response to the numerous questions raised about his work, Rabinowitz countercharges that millions of dollars worth of federally-funded research has failed to show that an EMP-related effect of serious proportions would occur. He specifically cites work done at Oak Ridge, which "has yet to demonstrate any appreciable effect." To back his conclusion that an EMP poses no grave danger to the electrical distribution system, he refers to statements made by officials of the Defense Nuclear Agency that downplay the risk of a widespread impact.

In a related paper, Tesche compares modeling systems for estimating the effects of EMP on overhead power lines. His work was done under subcontract to Oak Ridge and was sponsored in part by the Department of Energy.

A copy of Rabinowitz's *The Nuclear Electromagnetic Pulse and the Electric Power Grid: A Different Perspective* (EPRI EL-4351-SR), October 1987, is available for $32.50 from Research Reports Center, Box 50490, Palo Alto, CA 94303, (415) 965-4081. See also Rabinowitz's "Effect of the Fast Nuclear Electromagnetic Pulse on the Electric Power Grid Nationwide: A Different View," *IEEE Transactions on Power Delivery*, 2, pp.1199-1222 (includes comments and responses), October 1987, and F.M. Tesche's "A Study of Overhead Line Responses to High-Altitude Electromagnetic Pulse Environments," *EMP Interaction Note 458*, December 1986.

Navy Technician Wins $131,000 Out-of-Court Settlement

Joseph Coatney, a former U.S. Navy radar technician who developed cataracts, won an out-of-court $131,000 settlement from six radar manufacturers, according to his attorney, John Sweeney of Sweeney & Pafundi in Westlake Village, CA.

Sweeney related the following details of Coatney's story to *Microwave News:*

Beginning in September 1969, Joseph Coatney, then 18-years-old, served aboard the USS Springfield, a guided missile cruiser. For two years, Coatney was regularly exposed to radiation from surface, air-search and fire-control radars. Six years later, at the age of 24, Coatney was diagnosed as having bilateral, posterior, subcapsular cataracts and subsequently had corrective surgery. There was no history of cataracts in Coatney's family.

In 1981, while researching government reports in an effort to find out the cause of his cataracts, Coatney received an anonymous telephone call from a Food and Drug Administration employee. She said that she was contacting him out of personal concern for his condition. She told Coatney that his eye problems were common to many military personnel exposed to radar radiation. She also put him in touch with the Radar Victims Network, then led by Joe Towne, who himself had developed cataracts and other ailments.

In August 1982, Coatney sued Hughes Aircraft, Westinghouse, Raytheon, Sperry, General Electric and Sylvania and also named General Dynamics, the general contractor for the Springfield. Coatney contended that all of the manufacturers of the ship's radar equipment shared responsibility for his condition – it was difficult to

determine the extent of each manufacturer's contribution to his condition.

Just before Coatney's scheduled trial date in August 1987, the $131,000 settlement was reached. General Dynamics contributed only a small amount to the award.

Most radar compensation cases are settled out-of-court, with a stipulation that the terms of the agreement be kept confidential. Nevertheless, details on some of these cases have leaked out. In 1981, Ronald Karras won a $200,000 settlement from General Electric and Western Electric for multiple injuries (see *MWN*, July/August 1981). That same year, Leo Foley settled his claim for $25,000 against General Electric, Hughes Aircraft, Hazeltine, Lockheed Aircraft, Philco-Ford, Raytheon and Telerad-Lionel (see *MWN*, November 1981). And in 1982, Joseph Kerch received $30,000 from Air America for cataracts caused by radar and navigational equipment (see *MWN*, December 1982).

Sweeney also reported that Roy Josey won $171,000 from the U.S. Air Force in 1970 for radiation-induced cataracts. In addition, Towne – who died in 1985 – was awarded a $55,000 settlement and, although barred from revealing the figure, he never shied away from sharing this information (see *MWN*, January/February 1986).

FROM THE FIELD

Draft IRPA Exposure Limits for ELF EMFs

Reprinted below are the draft Guidelines on Limits of Exposure to Electric and Magnetic Fields at Power Frequencies of 50/60 Hz, *proposed by the International Non-Ionizing Radiation Committee of the International Radiation Protection Association (INIRC/IRPA). The review draft, dated May 12, 1987, has two appendices with rationales for the electric and magnetic field limits. Much of these is based on two previous IRPA documents on extremely low frequency (ELF) fields and on magnetic fields (see p.3, and* MWN, *December 1984 and March/April 1987, respectively). The draft also features a list of 22 references – half pre-1980 and half post-1980.*

The INIRC/IRPA argues that: "The epidemiological studies... suggesting a relationship between childhood or adult cancer and residence in houses at various distances from high current flow due to external electrical wiring configurations, cannot be considered in a health risk evaluation, because of the many deficiencies inherent in these studies. Several studies analyzing the incidence of cancer or mortality from cancer among arbitrarily defined occupational groups exposed to electromagnetic fields (among other factors) suggested an association between 'electrical occupations' and cancer. Because of the inherent uncertainty associated with this type of epidemiological study, and the lack of measurement of exposure, no definite conclusion can be drawn. The questions raised by these reports are serious enough to necessitate further investigation." The only two epidemiological studies listed in the references are the 1979 and 1982 studies by Dr. Nancy Wertheimer and Ed Leeper.

The members of the INIRC/IRPA that drafted the guidelines are: Drs. H. Jammet (chairman), France; J. Bernhardt, F.R.G.; B. Bosnjakovic, The Netherlands; P. Czerski, U.S.; M. Grandolfo, Italy; D. Harder, F.R.G.; B. Knave, Sweden; J. Marshall, U.K.; M. Repacholi, Australia; D. Sliney, U.S.; and J. Stolwijk, U.S. For more information, contact: A.S. Duchêne, scientific secretary, IRPA/INIRC, Institut de Protection et de Sûreté Nucléaire, Département de Protection Sanitaire, BP No.6, 92265 Fontenay-aux-Roses Cedex, France.

These limits apply to human exposure to E- and H-fields at frequencies of 50 or 60 Hz, and may be applied to the power frequency of 16.6 Hz. These limits should not be applied to ELF frequencies above 60 Hz.

General Public

Electric Fields: The general public should not be exposed to rms unperturbed E-field strengths above 10 kV/m. Short-term exposure (hours/day) to 10 kV/m is acceptable, however continuous exposure (24 hours/day) should be limited to rms fields less than 5 kV/m. Buildings intended for the use of members of the general public or for habitation should be erected only in a location where the unperturbed E-field strength outside the building 1.5 m above the ground and not less than 1.5 m from the building does not exceed 5 kV/m. The same restriction applies to open space areas where members of the general public might reasonably be expected to spend a substantial part of the day, such as recreational areas, sport facilities, meeting grounds and similar.

Magnetic Fields: The general public should not be exposed to rms H-field strengths above 0.2 mT.

Occupational

Electric Fields: Occupational exposure should not exceed 30 kV/m. For rms field strengths ranging from 20 to 30 kV/m the duration of exposure should be limited as much as possible. It is recommended that the duration of such exposure does not exceed 2 hours/day, and that during the remaining portion of the workday the exposure levels be reduced to 10 kV/m. A continuous occupational exposure up to 10 kV/m is permitted.

Magnetic Fields: Continuous occupational exposure should not exceed a rms value of 5 mT. For shorter durations (up to 2 hours/workday) exposure levels up to 10 mT can be permitted. For exposure restricted to the limbs values up to 25 mT can be permitted.

Measurement

For measurement of the E-field strength, free-field probes that measure fields undistorted by objects (the so-called unperturbed fields) at points 1.5 m from the ground are recommended....To determine compliance with the exposure limits, the E- and H-field strengths should be determined in accordance with recommended practices....In particular, the E-field component should be determined at a distance of 1.5 m from dielectrics and at a height of 1.5 m from the ground, and for inhomogeneous H-fields the H-flux density should be averaged on a loop surface of 100 cm^2.

Concluding Remarks

The above guidelines will be subjected to periodic revision and amendment with advances in knowledge and identification of effects associated with particular frequencies and/or modes of generation.

Vernon, NJ: Cluster Continues

During the last five years, we have reported on the continuing controversy of the cluster of Down's syndrome and other genetic defects among babies born to residents of Vernon, NJ. (See MWN, *November 1982, September 1984, May and November/December 1985 and July/August 1986.) In the letter reprinted below, Dr. Robert Becker, formerly a professor at the State University of New York Upstate Medical Center in Syracuse, and now a consultant, writes that the cluster continues to grow.*

There appears to be a misconception as to the current status of the incidence of genetic defects in Vernon, NJ. It is frequently stated that no new cases have occurred since January 1, 1985, and, since the number of microwave sources in the town has steadily increased since the late 1970s, there can be no causal relationship between the levels of microwaves and such defects. I have assisted the citizens' group, CAT, in collecting and evaluating data since 1981, and am familiar with the current situation. In 1986, one case of Down's syndrome was born. In 1987, there were two other Down's births (one Trisomy 21, the other T 13), as well as one other child born with major defects in 3 chromosomes.

The yearly incidence of proven genetic defects in Vernon reveals a possible periodicity of occurrence. The following table lists the 17 cases (Down's-11, Edward's-2 and other chromosomal anomalies-4) by year of birth.

1975—2	1979—3	1982—1	1985—0
1976—0	1980—2	1983—1	1986—1
1977—0	1981—2	1984—1	1987—3
1978—1			

If a periodicity does exist and a peak was reached in 1980, it is possible that the cases occurring in 1986 and 1987 represent the beginning of a second peak in incidence. In any event, the data may be interpreted to indicate the following: First, an overage of genetic defects does exist in Vernon (expected number: 3.4 cases; actual number: 17 – approximately a 500% excess since 1975). It should be noted that these data were gathered by voluntary reporting to the citizens' group; the actual incidence is likely higher than these figures indicate. Second, the situation in Vernon has not gone away, the genetic disease incidence is again on the rise. Third, there is not a direct linear relationship between the field strength of the microwaves and the incidence of genetic abnormalities. This suggests that the microwaves may be a cofactor and a second variable may be involved. At present I am attempting to evaluate the possible role of the geomagnetic field in this periodicity.

It is clearly evident that a health problem of considerable magnitude continues to exist in Vernon and may be related, at least in part, to the levels of microwave radiation present in the town.

Robert O. Becker, MD
Star Route
Lowville, NY 13367

Ongoing Research on Power Line Electric and Magnetic Fields

The information below, current as of January 1, 1988, is adapted from a table assembled by Dr. Lee Rosen of W/L Associates, a consulting firm based in Frederick, MD.

Institution	*Source*	*Exposure*	*Subjects*	*Comments*
Argonne Natl. Lab.	DOE	E	Rodents	Characterization of circadian phase shifts.
Battelle Pacific NW Lab.	EPRI	E	Rodents	Immune stimulation – cellular and humoral.
	DOE	E	Rodents	Neuroendocrinology, tumor induction, behavior.
	DOE	E&M	In vitro	Characterization of membrane effects, oncogene studies, DNA sensitivity.
	EPRI	M	Humans	Use of E-blankets to test human pineal hormonal response.
Elect. Res. & Management	EPRI	M	Engineering	Addition of M-field to previously built E-field facilities for teratology.
Enertech Consultants	EPRI	M	Engineering	Exposure assessment instrumentation and software for computer modeling.
Johns Hopkins U.	EPRI	Occup.	Workers	Retrospective case control study of AT&T workers with field measurements.
Lawrence Berkeley Lab.	DOE	M	In vitro	Membrane studies, phase transitions.
McGill U.	OH & HQ*	Occup.	Workers	Use of records from Canadian and French utilities.
Midwest Res. Inst.	DOE	E&M	Humans	Acute exposure to continuous and intermittent fields.
SW Res. Inst.	DOE	E	Primates	Operant and social behavior.
Oakland U.	DOE	M	In vitro	Cyclotron resonance studies; calcium markers.
U. of North Carolina	EPRI	Occup.	Workers	Leukemia and brain cancer among electric utility workers.
U. of Rochester	DOE	E	Rodents	Operant behavior.
U. of the South	EPRI	E	Engineering	Scaling study related to cage conditions and the impact of animals on dosimetry.
U. of Southern CA	EPRI	Resid.	Children	Case control study of childhood leukemia.
	EPRI	M	Workers	Characterization of occupational exposures.
U.S. VA, Loma Linda, CA	DOE	E&M	In vitro	Characterization of cell membrane response to applied fields.
	DOE	E	Rodents	Evaluation of mechanisms of interaction to applied fields.

* Ontario Hydro and Hydro Quebec

UPDATES

BIOLOGICAL EFFECTS

Risks of Controlling Static... An anti-static agent in plastic tote boxes was responsible for an outbreak of dermatitis among employees of a microelectronics firm, according to a NIOSH study by Dr. Diane Bennett and coworkers. The anti-static agent, bis-hydroxyethyl-tallow amine (BHETA), which was detectable as an oily film on the surfaces of the boxes, caused skin rashes on the hands and arms of 14 out of 29 of those working in direct contact with it. Employees also noted corrosion of electrical equipment stored in the treated boxes. Researchers investigating the problem concluded that BHETA is a strong skin irritant and a potential skin sensitizer. The study appeared in the *Journal of Occupational Medicine, 30,* pp.252-255, March 1988. For more information, contact: Dr. Toby Mathias, NIOSH, R-13, 4676 Columbia Pkwy, Cincinnati, OH 45226.

COMPATIBILITY & INTERFERENCE

Thiokol Fined for ESD-Sparked MX Fire...A team of U.S. Air Force investigators has concluded that a December 29 MX missile explosion at a Morton Thiokol plant in Utah was caused by electrostatic discharge (ESD) or friction. The Utah Division of Occupational Safety and Health has fined Thiokol $31,700 for "willful" and "serious" safety violations committed by the company and by the five workers who died in the fire. Thiokol officials say the company will appeal the fine (see *MWN*, September/October 1987 and January/February 1988).

Tips for Fixing EMI... The Electronics Industries Association (EIA) and the FCC have released a pamphlet, *Consumers Should Know Something About Interference: Tips on Searching It Out – and Some Fixes.* It explains the common types of EMI to consumer electronic products – TVs, VCRs, stereos and cordless phones – and how to resolve them. Copies are available from: Consumer Affairs, EIA, 2001 Eye St., NW, Washington, DC 20006; or from: Public Service Division, FCC, Room 725, 1919 M St., NW, Washington, DC 20554.

Post Office EMC Tests... The U.S. Postal Service (USPS) is seeking a contractor to perform EMI tests on six different types of stamp vending machines. The bidder chosen will determine whether the equipment meets military standards for conducted and radiated susceptibility in the 10 kHz to 1 GHz frequency range. Proposals for the one-year project were due April 18. For more information on solicitation No. 104230-88-B-0071, contact: C. Kennedy, USPS Headquarters, Office of Procurement, Room 1131, 475 L'Enfant Plaza West, SW, Washington, DC 20260, (202) 268-4103.

MEETINGS

BEMS Symposia... In addition to the usual complement of papers, posters and workshops, the *10th Annual Meeting of the Bioelectromagnetics Society* (BEMS), to be held June 19-23 in Stamford, CT, will feature four symposia: (1) Microwave Hyperthermia for Cancer Treatment; (2) Use of Electric and Magnetic Fields for Tissue Healing; (3) Mechanisms of Interaction of Electric Fields with Cell Membranes; and (4) Behavioral and Physiological Effects of High Peak Power Microwave Pulses. The first two symposia have been approved for continuing medical education (CME) credit. The meeting will be held at the Westin Hotel, which is offering a $58/night (single or double) discount rate for BEMS conferees. To make a reservation, call: (800) 231-2042. For more information about the meeting, contact: BEMS Executive Director Dr. William Wisecup, 120 W. Church St., Frederick, MD 21701, (301) 663-4252.

VDT Measurements... The IEEE EMC Society's Working Group P1140 on *Near-Field Testing Procedures for Electric and Magnetic Fields* will meet on or around June 17 in Connecticut. The time and location will be set to coordinate with the BEMS meeting. The working group had originally planned to meet in March, but the session was canceled because Swedish researchers were unable to attend. On the agenda are reviews of spectral energy and time derivative methods, as well as a report from Finland. For more information, contact: Stephen Berger, Electro-Mechanics Co., 10620 Metric Blvd., Austin, TX 78758, (512) 835-4684. (See also *MWN*, July/August 1987.)

HPM Weapons... The *4th National Conference on High Power Microwave Technology for Defense Applications* will be held at the U.S. Naval Post Graduate School in Monterey, CA, May 9-13. The objective of the conference is "to examine the service operational mission utility and weapons potential of high power microwaves" (HPM). Among the papers scheduled are a report on susceptibility measurements on an M1 tank and studies of avionics and the effects of HPMs on an artillery fuse. There will be a session on bioeffects, chaired by Dr. John de Lorge of the Naval Aerospace Medical Research Lab in Pensacola, FL, who will also review the behavioral effects of HPMs. Representing the other services, Howard Bassen will discuss the army's program and James Merritt will go over the USAF's research. Over 600 scientists and engineers attended the third HPM meeting in December 1986 (see *MWN*, January/February 1987 and January/February 1988). Attendees must have a "secret" security clearance. For more information, contact: Kindra Landry, American Defense Preparedness Association, Rosslyn Center, 1700 North Moore St., Suite 900, Arlington, VA 22209, (703) 522-1820.

1989 Zurich EMC Symposium...A call for papers has been issued for the *8th International Symposium and Technical Exhibition on Electromagnetic Compatibility*, which will be held in Zurich, March 7-9, 1989. This biannual meeting attracts experts from all over the world: the 1987 symposium had 930 participants from 28 different countries. For more

information, contact: Dr. T. Dvorak, ETH-Zentrum-IKT, CH-8092 Zurich, Switzerland, (1) 256-2790; or in the U.S., Dr. Ralph Showers, Dept. of Electrical Engineering, University of Pennsylvania, Philadelphia, PA 19104, (215) 898-8123.

MILITARY SYSTEMS

Ideas for Weapons... The Naval Surface Warfare Center (NSWC) and the Defense Advanced Research Projects Agency are accepting proposals "in microwave effects testing and compact source development" through June 30. Specifically, the proposed research should include experiments demonstrating "the enhanced effects of frequency modulation, multiple frequencies, waveform modulation and pulse shaping of microwaves on electronics systems." For more information, contact: Karen Jackson, Code S22, White Oak Laboratory, NSWC, 10901 New Hampshire Ave., Silver Spring, MD 20903.

OTH-B Radar Operational... The over-the-horizon backscatter (OTH-B) radar system, which can detect cruise missiles up to 2,000 miles away and "at ranges almost 10 times further than conventional ground-based radars," is now operating at limited capacity in Moscow, ME. The Electronic Systems Division of the USAF is now testing the system 12 hours/day, rather than full-time, due to software development problems. The radar, which transmits signals in the 5-28 MHz range, is expected to be fully operational next year when General Electric, the system's contractor, finishes work on the system's third sector and completes the software design. Another OTH-B is already under construction on the West Coast and the USAF has plans for one in Alaska and one in the Midwest – though these are now in doubt; in late March, a House subcommittee canceled the USAF's $161 million request for OTH-B procurement....Meanwhile, the Navy is scheduled to move its relocatable over-the-horizon radar (ROTHR) from Virginia to Amchitka Island in the Aleutians to detect Soviet aircraft and ships. The USAF and the Navy will link their systems to "provide wide area surveillance," reports *Aviation Week* (March 21).

PEOPLE

The top EMF journals are going through changes. Dr. **Don McRee** of NIEHS was scheduled to become editor-in-chief of *Bioelectromagnetics* but had to decline due to time constraints. EPA's Dr. **Richard Phillips** will continue to run the journal, published by the Bioelectromagnetics Society, until a replacement is named. A search is also underway at *The Journal of Microwave Power and Electromagnetic Energy*, published by the International Microwave Power Institute (IMPI) – Dr. Geoffrey Voss of Voss Associates Engineering in Victoria, Canada, has resigned as the editor. And the officers of the Health Physics Society are not only looking for someone to replace Dr. **Genevieve Roessler** as the editor of *Health Physics*, but also for a replacement for **John Tolan**, who is stepping down as editor of the society's *Newsletter*. At the *IEEE Transactions on EMC*, the succession is settled: Dr. **Motohisa Kanda** has taken over as editor from **Richard Schulz**, a consultant who retired from Xerox Corp. not long ago. In March, the first issue of *Microwave and Optical Technology Letters* will appear. Published ten times a year by Wiley-Interscience and edited by Professor **Kai Chang** of Texas A&M, the journal promises quick publication – no more than two-four months from time of submission. Another new publication is the quarterly *Journal of Electromagnetic Waves and Applications*, edited by **J.A. Kong** of MIT and published by VNU Science Press in The Netherlands.

A number of bioeffects and EMC researchers were recently named IEEE Fellows: Drs. **Kenneth Foster** of the University of Pennsylvania and **Saul Rosenthal** of Polytechnic University were elected for their work on bioeffects, and **Ed Bronaugh** of Electro-Metrics, Dr. **Motohisa Kanda** of NBS and **Henry Ott** of AT&T Bell Labs were named for their contributions to EMC studies....**Stanley Salek**, formerly with Circuit Research Labs in Tempe, AZ, has joined the NAB as a staff engineer....**Franklin Jarman** has been forced out as acting chief executive officer of Clini-Therm Corp., a manufacturer of hyperthermia treatment units. **Charles Hill**, a management consultant, is taking over on an interim basis.

STANDARDS

CISPR Draft Rules...CISPR subcommittees have released the following six-month draft rules: (1) *Limits and Methods of Measurement of Radio Interference Characteristics of Vehicles, Motor Boats, and Spark-Ignited Engine-Driven Devices*, CISPR/D(Central Office)17 ($28.00); (2) Seven amendments to CISPR 14, *Limits and Methods of Measurement of Radio Interference Characteristics of Household Electrical Appliances, Portable Tools and Similar Electrical Apparatus*, CISPR/F(Central Office)44-50 ($51.00 for the set); (3) Three amendments to CISPR 15, *Limits and Methods of Measurement of Radio Interference Characteristics of Fluorescent Lamps and Luminaires*, CISPR/F(Central Office)51-53 ($23.00 for the set); and (4) Four amendments to CISPR 16, *CISPR Specifications for Radio Interference Measuring Apparatus and Measurement Methods*, CISPR/A(Central Office)42-45 ($63.00 for the set). All are available (prepaid) from: ANSI, International Sales Department, 1430 Broadway, New York, NY 10018, (212) 642-4900.

Radiated and Conducted Emissions...ANSI has requested comments on drafts of a number of new and revised standards: (1) *Recommended Practice for the Measurement of RF Emissions from Industrial, Scientific and Medical Equipment Installed on User's Premises, BSR/IEEE 139* ($15.00); (2) A revision and redesignation of ANSI C16.25-1962, *Procedure for Measuring Conducted Emissions in the Range of 300 kHz*

to 25 MHz from FM and Television Broadcast Receivers to Power Lines ($10.00); (3) A proposed revision of ANSI C63.4-1981, *Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronics Equipment in the Range of 10 kHz to 1 GHz, BSR C63.4* ($10.00); (4) *Calibration of Antennas Used for Radiated Emissions Measurements in Electromagnetic Interference (EMI) Control, BSR C63.5* – methods for determining antenna factors for radiated emissions from 30 MHz to 1 GHz ($10.00); (5) *Guide for the Computation of Errors in Open-Area Test Site Measurements, BSR C63.6* – explanation of the basis of the ±4dB criterion for the site attenuation measurements required in C63.4 ($6.00); and (6) *Guide for Construction of Open-Area Test Sites for Performing Radiated Emission Measurements, BSR C63.7* – information on emissions in the range of 30-1000 MHz ($8.00). The first two drafts are available from O. Edwards, and the others from Fred Huber, Jr., both at: IEEE, 345 East 47th St., New York, NY 10017.

ETC...

Literature Review... For its 22nd general assembly, held last summer in Tel Aviv, URSI prepared a *Review of Radio Science 1984-1986*. (Similar reviews were put together for its previous triennial meetings.) The volume, which was edited by Dr. Geoffrey Hyde of Comsat, covers all the major areas of communications, including EMI and bioeffects. The chapters on "EM Noise and Interference" and on "Bioeffects of EM Waves" were assembled by H. Kikuchi of Japan and Cesar Romero-Sierra of Canada, respectively. Each chapter features extensive references. A copy of the review is available for $20.00, which includes surface postage, from: URSI, 3 Ave. Circulaire, B-1180 Brussels, Belgium.

CONFERENCES

New Listings

May 1-5: **3rd Annual High Frequency Power Conversion Conference,** Princess Resort Hotel, San Diego, CA. Contact: Intertec Communications, Inc., 2472 Eastman Ave., Bldg. #33-34, Ventura, CA 93003, (805) 658-0933.

May 9-13: **4th National Conference on High Power Microwave Technology for Defense Applications,** U.S. Naval Post Graduate School, Monterey, CA. Contact: Kindra Landry, American Defense Preparedness Association, Rosslyn Center, 1700 North Moore St., Suite 900, Arlington, VA 22209, (703) 522-1820.

May 12-17: **Spring Conference of the Society of Telecommunications Consultants (STC),** Hyatt Regency Alicante Hotel, Garden Grove, CA. Contact: STC, 1841 Broadway, Suite 1203, New York, NY 10023, (212) 582-3909.

June 7-10: **Conference on Precision Electromagnetic Measurements (CPEM'88),** Tsukuba Science Center, Japan. Contact: CPEM'88 Secretariat, 2-40-14, Hongo, Bunkyo-ku, Tokyo 113, Japan.

June 23-25: **2nd European Congress of NMR in Medicine and Biology,** Hotel Inter-Continental, Berlin, F.R.G. Contact: Dr. C.D. Claussen, Radiologische Klinik, Freie Universität Berlin, Spandauer Damm 130, 1000 Berlin 19, F.R.G., (030) 30 35-821.

June 25-26: **4th National Standing Conference on Low-Level Radiation and Health,** Stirling, Scotland, U.K. Contact: M. Crankshaw, 20 Reedloch Dr., Barrassie, Troon, KA10 6UK, Scotland, U.K., (0292) 316008.

July 5-7: **Military Microwaves '88,** Wembley Conference Center, London, U.K. Contact: Patrick Pinches, Microwave Exhibition and Publishers Ltd., 90 Calverley Road, Tunbridge Wells, Kent TN1 2UN, U.K., (0892) 44027.

October 16-20: **1988 Conference on Electrical Insulation and Dielectric Phenomena,** Skyline Hotel, Ottawa, Canada. Contact: Prof. Marshall Pace, Dept. of Electrical and Computer Engineering, University of Tennessee, Knoxville, TN 37996, (615) 974-5419.

November 9-11: **21st Annual Electronics and Aerospace Conference (EASCON 88),** Hyatt Regency Crystal City, Arlington, VA. Contact: Wilbur Pritchard, SSE Telecom, 7200 Wisconsin Ave., Bethesda, MD 20814.

April 2-7, 1989: **1989 IEEE/PES Transmission and Distribution Conference and Exposition,** Convention Center, New Orleans, LA. Contact: Donald Preston, Louisiana Power & Light Co., PO Box 6008 (L-319), New Orleans, LA 70174, (504) 363-8735.

September 11-14, 1989: **Work with Display Units 89 (WWDU89),** Queen Elizabeth Hotel, Montreal, Canada. Contact: WWDU89, Institut de Recherche en Santé et en Sécurité du Travail du Québec, 505 boul. de Maisonneuve Ouest, Montreal, Québec H3A 3C2, Canada, (514) 288-1551.

Upcoming Meetings

May 10-12: **EMC Expo-88,** Washington Hilton Hotel, Washington, DC. Contact: Karen Smith, EMC Expo-88, PO Box D, Gainesville, VA 22065, (703) 347-0030.

May 16-19: **20th Annual Meeting of the Conference of Radiation Control Program Directors (CRCPD),** Hyatt Regency, Nashville, TN. Contact: CRCPD, 71 Fountain Pl., Frankfort, KY 40601, (502) 227-4543.

May 25-27: **1988 IEEE MTT-S International Microwave Symposium,** New York, NY. Contact: Jesse Taub, LRW Associates, 1218 Balfour Dr., Arnold, MD 21012, (516) 595-4288.

June 19-24: **10th Annual Meeting of the Bioelectromagnetics Society (BEMS),** Westin Hotel, Stamford, CT. Contact: BEMS, 120 W. Church St., Frederick, MD 21701, (301) 663-4252.

June 28-30: **9th International Wroclaw Symposium on Electromagnetic Compatibility (EMC),** Wroclaw, Poland. Contact: W. Moron, EMC Symposium, 51-645 Wroclaw 12, Box 2141, Poland.

July 4-8: **33rd Annual Meeting of the Health Physics Society (HPS),** Sheraton Boston Hotel & Towers, Boston, MA. Contact: HPS, 8000 Westpark Dr., Suite 400, McLean, VA 22102, (703) 790-1745.

July 24-29: **1988 Power Engineering Society Summer Meeting,** Hilton and Marriott Hotels, Portland, OR. Contact: IEEE Society Special Services, 345 East 47th St., New York, NY 10017, (212) 705-7895.

August 2-4: **IEEE 1988 International Symposium on Electromagnetic Compatibility,** Westin Hotel, Seattle, WA. Contact: Don Weber, Hamilton Engineering Inc., 2108 SW 152nd St., Seattle, WA 98166, (206) 244-0952.

telephone interview, "The effect is real. It is produced by a low-level magnetic field, but we don't yet know what the important parameters of the field are."

Monahan's lab was one of the two in which a statistically significant increase in abnormalities was found. The other significant findings were reported by Dr. Alexander Martin of the University of Western Ontario in London, Canada.

Similarly, Dr. Ezra Berman of the Environmental Protection Agency (EPA) in Research Triangle Park, NC, who is coordinating the Henhouse project, told *Microwave News* that, "This study has contributed significantly to the growing data base implicating an association of PMFs of very low frequency and/or very low intensity in the increase of abnormalities in chick embryos."

Berman will discuss the Henhouse results at the *Annual Meeting of the Electromagnetic Energy Policy Alliance* on April 21 in Alexandria, VA, before making the official presentation at the BEMS meeting in Stamford, CT, June 19-24.

In addition to Leal, Martin and Monahan, the other Henhouse researchers are Drs. William Koch of the University of North Carolina (UNC) in Chapel Hill, Kjell Hansson Mild of the National Institute of Occupational Health in Umea, Sweden, and Graciela Martucci, formerly with the EPA in Las Vegas, NV.

The six research teams used identical equipment and similar experimental procedures; only the chick eggs came from different sources. Altogether, they ran a total of 60 experiments. The eggs were exposed to a 1 μT PMF – each pulse had a 2 μsec fall and rise time with a 500 μsec duration – for the first 48 hours of incubation.

BEMS Henhouse Abstract

The effect in chick embryos of exposure to pulsed magnetic fields (PMFs) was investigated by six independent laboratories in Europe, Canada, and the U.S. Each laboratory was identically equipped with incubators containing Helmholtz coils, electrical devices to develop and observe the pulse, and monitors of the temperature, relative humidity, and vibration of each incubator. Each laboratory conducted 10 runs of 20 eggs (10/sham or treated) exposed to unipolar pulsed magnetic fields (1 μT, 500 μs duration, 2 μs rise and fall time, 100 Hz repetition) for the first 48 hours of incubation. Eggs were evaluated for fertility, and embryos for the presence of development, normal structure, and maturity. Two of six laboratories showed a significant ($p<0.001$ and $p=0.03$) increase in the proportion of abnormal embryos in the treated group, and so did the project as a whole ($p=0.001$). The interaction between treatment and laboratory where the experiment was conducted was significant ($p=0.015$) for the proportion of abnormal embryos. Statistical differences in the proportion of live embryos ($p=0.01$) and in their maturity, as measured by the number of somite pairs ($p=0.002$) and the Hamburger and Hamilton stage ($p=0.005$), were related to the laboratory and not to exposure. Apparently, very low-level, very low-frequency, pulsed magnetic fields contribute to increased abnormality incidences in early embryonic chicks without concomitant changes in maturity. (Supported by ONR and EPA.)

EPA's Ric Tell designed and built the exposure systems, which control all the major physical variables – for instance, temperature, humidity and mechanical stability. Tell, who last year left EPA to open his own consulting firm, told *Microwave News* that, "The Henhouse project probably represents one of the most carefully done experiments...aimed at exploring the biological effectiveness of weak PMFs."

Although the field affected the incidence of abnormalities among the developed embryos, it did not change the ratio of developed to non-developed (alive to dead) organisms or the rate of growth of the morphologically normal embryos. There is no clear explanation for the variation in the experimental results from the six labs.

Leal believes that genetic factors could explain some of the differences. For instance, she said that the one group that did not find an increase in abnormalities – Koch's team at UNC – used a breed of chick eggs which was genetically very different from that used by the other five labs. According to EPA's Berman, Koch exposed White Rock eggs, while the others used White Leghorn eggs. Leal pointed out that the new results reinforce what her group found some years ago – that weak PMFs are effective but that the biological response is modulated by "uncontrolled factors."

In addition, in a paper published last year, Leal and coworkers showed that the teratogenic effect of PMFs depended on the orientation of the chick embryos. They concluded that, "By changing their orientation, the embryos could escape the potential teratogenic effect of a field exposure on their development" (see *Medical Science Research, 15*, pp.531-532, 1987). In a previous paper, Leal's group reported on the influence of the Earth's magnetic field on the development of chick embryos (see *MWN*, January/February 1987).

The Spanish Ministry of Health is sponsoring a meeting for the members of the Henhouse project in Madrid, April 25-29. In addition to planning the next series of experiments, the researchers will discuss possible sources of funding to keep their research going – the ONR money has run out. IBM is considering funding the continued work of the project, according to a company spokesperson.

The impact of the Henhouse results on the debate over possible ill effects among pregnant VDT operators is as yet unclear. The type of PMF used by the Henhouse teams was different from that emitted by the flyback transformer in cathode ray tube-type VDTs, and a chick embryo is quite unlike a human fetus. Not surprisingly, most experts shied away from extrapolating the results to humans and VDTs. As Leal told *Microwave News* from Madrid, "Possible effects of VDT fields on the human fetus can only be known through an epidemiological study."

The spokesperson for IBM also cautioned against applying the chick egg results to other species – especially humans. She said that, "It would seem that the only prudent conclusion to draw at this time from the Henhouse investigation is that further research is needed to better understand electromagnetic fields."

Dave Janes, a division director at the Environmental Protection Agency (EPA) and the chairman of the C95.IV risk assessment group, compared the subcommittee to "a rudderless ship." Asked about the status of the revision of the health standard, Janes told *Microwave News*, "I haven't the foggiest notion in the world."

One of the clouds hanging over the members of C95 is the fear of personal liability if the standard is later contested in court. The Navy and the IEEE have so far refused to indemnify the working members from future legal challenges.

According to Dr. John Osepchuk of Raytheon, the secretary of C95.IV, this lack of protection was a factor in Storm's decision to resign. Indeed, in his letter of resignation, Storm, a hyperthermia specialist at the University of Wisconsin in Madison, advised Rosenthal to consider appointing a chairman of C95.IV from the ranks of industry – and thus protected by his or her company – since "the chairman will be the first-named in a lawsuit against the committee."

Nevertheless, Rosenthal appointed Drs. Om Gandhi of the University of Utah in Salt Lake City and Eleanor Adair of the John Pierce Foundation in New Haven, CT, as interim co-chairs of C95.IV until a new chairman of C95 is appointed.

In a telephone interview, Gandhi said that, "The first order of business is to get some kind of liability insurance for the members." Gandhi believes that over two-thirds of the subcommittee are concerned over liability: "Realistically, concrete action cannot be taken until the liability cloud is lifted."

An IEEE Committee

The most likely solution to the legal dilemma is for C95 to become an IEEE committee. Gandhi said that a petition to the IEEE is being drafted. According to Rosenthal, the petition will be forwarded to the IEEE Standards Board for its June meeting.

Henry Bachman, the past president of the IEEE and a vice president at Hazeltine Corp., said that he would welcome the committee because the radiation issue is of direct relevance to the institute. But, as Andy Salem, the director of standards at the IEEE, pointed out to *Microwave News*, C95 would have to operate under IEEE procedures: "They will have to decide whether to trade their independence for good management."

If C95 does become an IEEE committee, its members will be indemnified, Salem said. However, he added that it is out of the question for the institute to provide funds for the committee's operation – that is up to industries and organizations which have an interest in the standard.

No one anticipates any progress on the revision until the C95 organizational problems are worked out. As Dr. Max Weiss of AT&T Bell Labs said, "Until the bureaucratic situation is resolved, we can't do very much."

Under ANSI's rules, all standards must be revised or reaffirmed every five years. The ANSI C95.1-1982 guidelines are thus already technically out-of-date.

Frustration among the C95.IV membership has mounted since 1983, when Storm first set up a complex system of committees, subcommittees and working groups to evaluate the RF/MW bioeffects literature (see *MWN*, July/August 1983). The following year, complaints were already surfacing over the unwieldy structure and slow pace of the revision process (see *MWN*, October 1984). After entering the maze for review, some papers seemed to disappear.

Nothing changed, however, and two years later, in Madison, WI, the debate became tense as proposed revisions were announced before the literature review was complete. Many subcommittee members balked at having to vote on the proposals (see *MWN*, July/August 1986).

In Madison, some C95.IV members refused to vote, citing their concerns over personal liability after Navy and IEEE staffers warned that they would not offer them indemnity. Since then, progress has been imperceptible. Storm did not attend last year's C95.IV meeting in Portland, OR.

In numerous interviews, many C95.IV members said they did not know the status of the revision. "As far as I am aware, no progress has been made since June 1987, and, if progress has been made, it has not been communicated to the subcommittee," said Jack Monahan, the C95.IV representative of the Food and Drug Administration's Center for Devices and Radiological Health.

Dr. Barbara Chang, chief of hematology and oncology at the VA Medical Center in Atlanta, GA, quit out of frustration over the group's disorganization. In her February 18 letter of resignation, Chang, one of the few medical doctors active on C95.IV, complained that, "Not only have we not received all of the articles we should have received in a timely fashion, but an organized effort at obtaining our reviews in a systematic, uniform manner has not been undertaken."

Substantive Issues

Once the organizational details are worked out, the C95.IV members must grapple with a host of equally complex technical and policy questions. For instance, the subcommittee still has not decided whether to adopt a two-tier standard with different limits for the general population and for workers – like the one recommended by the National Council on Radiation Protection and Measurements (NCRP). The 1982 ANSI guidelines applied the same limits to both groups. Also, there are proposals to extend the applicability of the standard down to 3 kHz and up to 300 GHz. At present, it only covers the 300 kHz-100 GHz frequency band.

The appointment of Gandhi as interim cochair will complicate the negotiations over loosening the 1982 limits at millimeter wave frequencies. In 1986, a proposal was offered to double the standard to 10 mW/cm^2 above 3 GHz – apparently to conform to infrared radiation exposure limits (see *MWN*, July/August 1986). But Gandhi has strongly criticized this change, arguing that millimeter waves and infrared radiation are very different because the former can penetrate clothing while the latter cannot. Asked whether he will maintain his opposition to relaxing the standard at higher frequencies, Gandhi replied, "Of course. I'm not giving up science."

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NAS-NRC: Skepticism over ELF Effects Without a Mechanism

At a March 14 workshop, members of a panel convened by the National Academy of Sciences-National Research Council (NAS-NRC) expressed skepticism about the possible role of weak extremely low frequency (ELF) fields in the development of cancer. "We have not seen good basic research that could explain the epidemiological findings," Dr. Richard Setlow, the chairman of the panel, said in a telephone interview after the meeting.

After six invited speakers presented an overview of current ELF research, the three physicists on the NAS-NRC panel—Drs. Robert Pound, Herman Schwan and Eugene Stanley—all expressed doubt that low-intensity fields could be responsible for the observed increases in cancer rates

"Is there an effect?" Stanley asked rhetorically. For his part, he said that he is far from convinced. Stanley expressed his amazement at "the lack of coordination among studies," while acknowledging that the "main problem is a lack of funding." Nevertheless, he said that, "It's worth the agencies' money" to find out if there are health effects. He added that he would prefer science-based agencies like the National Institutes of Health and the National Science Foundation to sponsor ELF studies, rather than the Electric Power Research Institute (EPRI) and the Department of Defense, which have a stake in the results.

Those members of the panel with biological and epidemiological expertise had their own criticisms. For instance, Dr. Clark Heath described

(continued on p.14)

Florida Adopts First U.S. Power Line Magnetic Field Limits

Rules Are Challenged as Too Lax

The state of Florida has adopted the first power frequency magnetic field exposure standards in the United States. The magnetic field limits set by the state Department of Environmental Regulation (DER) are significantly weaker than those first proposed last year.

The standards, adopted at a January 18 public meeting, only apply to new transmission lines, but the regulations also specify more stringent limits for the 500 kV Lake Tarpon-Kathleen power line—the line is certified to operate at only 16% of its capacity, however.

"These are not health-based standards," the DER's Buck Oven told *Microwave News*. "Since at this point, we can't say what levels are safe, the standards are set on what is technologically achievable."

But residents of Hillsborough County—the site of the planned Lake

(continued on p.13)

Commerce Department and FCC Seek EPA RF/MW Rules

The National Telecommunications and Information Administration (NTIA), an arm of the Department of Commerce, has joined the chorus of those agencies trying to convince the Environmental Protection Agency (EPA) to issue federal standards for public exposures to radiofrequency and microwave (RF/MW) radiation.

In a February 24 letter to EPA Administrator William Reilly, Assistant Secretary of Commerce Alfred Sikes argued that, "It is important and in the public interest that the EPA continue its RF radiation activities and issue federal guidance."

Also, the Federal Communications Commission (FCC) has again expressed its "disappointment" that the EPA will not issue RF/MW limits. In a March 14 letter to the EPA, FCC Chief Engineer Thomas Stanley asked the EPA to consider developing an official position on nongovernmental safety standards that either have been or will soon be issued: "It would be of great benefit to the FCC and other agencies if the EPA would offer advice on the interpretation and supportability of existing nongovernmental RF standards." Stanley explained that, "In the next two years, the FCC may have to reconsider which nongovernmental RF exposure standard to use."

Last November, FCC Chairman Dennis Patrick asked the EPA to reconsider its decision to defer its rules (see *MWN*, N/D88). The FCC, like the NTIA, is concerned that without federal rules, state and local governments will issue "unduly restrictive" exposure standards. In its January 23 response, the EPA offered no encouragement that RF/MW limits might be forthcoming, but did say that the agency may publish a "Citizen's Guide" to RF radiation.

Stanley asked in the March letter whether the proposed citizen's guide would offer clues as to "what are considered to be 'safe' exposure levels?" He went on to express concern that the "EPA will lose the expertise necessary to maintain the interagency agreement and satisfy future demands to measure and analyze environmental RF exposure."

NTIA's Letter

In NTIA's letter to the EPA, Sikes was relaying the concerns of the Frequency Management Advisory Council (FMAC), an NTIA advisory committee. At its November 14 meeting, FMAC was briefed by Richard Guimond, the director of EPA's Office of Radiation Programs, who had decided to put the RF/MW rules on hold after more than ten years of development (see *MWN*, S/O88 and J/F89). Also present was Dr. Charles Süsskind of the University of California at Berkeley, who maintains that there is a clear constituency for a uniform, nationwide standard.

Members of FMAC decided to send the letter to the newly-installed EPA administrator. Dr. Sam Koslov of the Johns Hopkins University Applied Physics Lab was recruited to draft the letter, which advised the EPA that:

> Authoritative federal criteria are needed both as a basis for assuring safety and to prevent the costly and disruptive effect that the proliferation of piecemeal and diverse exposure criteria and regulations are having on the telecommunications industry. The absence of such criteria also contributes to public apprehension, litigation and controversy over the safety of RFR [RF radiation] and radiating equipment. Furthermore, other countries, large and small, have established or are developing standards to control exposures to RFR. International bodies have also recommended guidelines. U.S. companies competing to provide equipment and telecommunications services in world markets face uncertainties in complying with diverse criteria established by other countries or international bodies. Without established U.S. criteria as a basis for leadership, the U.S. weakens its position.
>
> We appreciate the demands of other important priorities competing for the limited budgetary and manpower resources available to EPA. However, considerable investment, effort and substantial progress have been made toward the issuance of RFR guidance by the EPA since the 1970s. Very little more is needed to complete the task at this stage as compared with the significant effort and additional resources that will be required to re-establish the activity later. We believe it is important and in the public interest that EPA continue its RF radiation activities and issue federal guidance.

DOD Launches Inter-Service EMI Study Project

The U.S. Department of Defense (DOD) has begun a three-year study of electromagnetic compatibility among electronic weapons systems used in the different branches of the military. The $30 million joint electromagnetic interference (JEMI) study project is headed by the U.S. Air Force's (USAF) Colonel Charles Quisenberry of the Tactical Air Warfare Center at Eglin Air Force Base (AFB) in Florida.

Quisenberry, who recently completed a seven-month, classified JEMI feasibility study, has stated that the investigation was prompted by the unexplained crash of a USAF F-111 jet during the 1986 raid on Libya, according to a January 19 Knight-Ridder news service report. Quisenberry said that radiofrequency (RF) interference might have led to the downing of the F-111: "It could have. We couldn't rule it out or say that that was the cause," Knight-Ridder reported.

Speculation that EMI was responsible for the F-111 loss was further fueled by an account of the incident by former Secretary of the Navy John Lehman, Jr. in his recently-published book, *Command of the Seas*. Lehman wrote that Navy pilots saw the F-111 crash into the water off the coast of Libya and then explode, but there was no indication that it had been hit, the February 13 *Air Force Times* reported.

After a detailed investigation, the USAF determined that the crash and other unexplained problems during the raid were due to a flood of electronic signals from Navy and USAF high power transmitters intended to jam Libyan air defenses: "The end result was we found out [that] we did it to our-

Navy Signals Jam Automatic Garage Door Openers

For two weeks in March, a mysterious signal jammed hundreds of radio-controlled garage door openers in the San Francisco Bay Area. The puzzle was solved on March 16 when the U.S. Navy announced that the electromagnetic interference (EMI) was caused by shore-to-ship communications. The Navy stopped its transmissions on March 15.

Using an antenna atop Mount Diablo, the Navy was transmitting at 311.6 MHz, according to Lt. John Murphy, a spokesman at the San Francisco Naval Base. Garage door openers operate in the 308-312 MHz frequency band.

When news of the EMI got out, the Navy was besieged with calls. "I was even contacted by the British Broadcasting Corporation (BBC)," Murphy told *Microwave News*. Murphy believes that widespread interest was sparked by rumors that the source of the EMI was top secret. "The BBC even asked about a link with the [NASA] shuttle," he said. He added that the transmissions were not classified. The rumors were no doubt fueled by a Federal Communications Commission spokesman who refused to divulge which governmental agency was responsible for the interfering signals.

The Navy usually uses telephone lines to communicate with its docked ships, Murphy pointed out, but there was a break in the system, which has since been repaired. Alternative means are being investigated for the future, Murphy said. "We don't want to be a bad neighbor."

In 1986, a similar problem occurred in southern California when President Reagan's E-4B—a specially-equipped Boeing 747 to be used in the event of nuclear war—caused garage door openers to malfunction (see *MWN*, M/J86).

selves," Quisenberry told Knight-Ridder.

A Pentagon spokesman, quoted in the February 13 *Air Force Times*, refuted Quisenberry's claims: "There is no indication...that EMI might have caused one of the fighters to crash and others to miss their targets, or that during the Libyan strike U.S. weapons were interfering with each other."

Quisenberry is no longer granting telephone interviews, a DOD spokeswoman told *Microwave News*.

The JEMI project, which is staffed by approximately 65 military and civilian experts at Eglin AFB, is the first major effort to investigate how RF signals from the weapons of one branch of the military might disrupt the electronics systems of another branch.

Among the goals of the project are to notify U.S. and allied commanders of potential problems and to recommend tactics to avoid them, either by assigning new frequencies to certain transmitters or by assuring that interfering weapons are kept far enough apart to prevent EMI, according to Knight-Ridder.

Quisenberry has proposed using the U.S. Army's UH-60 Black Hawk helicopter as a case study, according to the December 19, 1988, *Aviation Week & Space Technology*. The Black Hawk has been identified as vulnerable to EMI and has been implicated in a number of possible EMI-related accidents (see *MWN*, N/D87, S/O88 and N/D88). Another Army helicopter under investigation for susceptibility to EMI is the AH-64 Apache. A June 20, 1988, report from the DOD Inspector General pointed out that simple solutions to EMI do not always work: coating the doors of the Apache with a metallic paint did not solve the problem.

The DOD hopes to institutionalize the JEMI project after the three-year investigation is concluded, according to the December 19 *Aviation Week*.

EMI among military systems has become national news: On February 27, *Time* ran an item on the PAVE PAWS radar at Robins AFB, GA—where the main beam of the phased array poses a threat to electro-explosive devices aboard aircraft flying into the base—under the headline, "A $90 Million Mistake" (see *MWN*, J/A88, N/D88 and J/F89). The magazine also referred to the EMI problems plaguing the Black Hawk.

Higher Cancer Rates Near San Francisco's Sutro Tower

Between 1973 and 1985, in San Francisco's Noe and Eureka valleys, children under the age of 15 developed cancer at twice the expected rate for children in the Bay Area. The San Francisco Department of Public Health, which conducted a brief investigation, believes that the statistically significant increase (21 observed cases, as compared to 11.8 expected) may have occurred by chance. The department points out that there is no evidence of a continuing problem, since no new cases have been reported since 1986.

The search for the cause of the problem has yielded two potential candidates: radiofrequency (RF) radiation from the Mount Sutro tower—shared by five VHF and four UHF TV stations and four FM radio stations—atop Twin Peaks, which overlooks the Noe and Eureka valleys, and radioactive and toxic chemical emissions from the nearby University of California–San Francisco Medical Center. The wind patterns in the area argue against the emissions as the culprit, however.

In both April and December 1988, at the request of Sutro Tower Inc., engineers from Hammett & Edison, a San Francisco-based consulting firm, measured RF radiation levels near the tower and in the Noe and Eureka valleys. Typical values in publicly accessible areas close to the tower were in the 3-10 $\mu W/cm^2$ range—the highest reading was 530 $\mu W/cm^2$ in a small area near a lamppost. (Similar readings were found in a 1985 survey.) In the Noe and Eureka valleys, typical readings were 0.5 $\mu W/cm^2$, with a maximum of 2.6 $\mu W/cm^2$.

William Hammett, who took the December 1988 measurements, told *Microwave News* that the city of San Francisco had recently run its own RF survey and had obtained similar readings.

The city Department of Public Health said that it will continue to monitor the rates of childhood cancer.

FCC Proposes Revising EMI Measurements for Computers

The Federal Communications Commission (FCC) has proposed revising its rules for measuring electromagnetic emissions from digital devices such as computers. The revised rules, *FCC Procedure for Measuring Electromagnetic Emissions from Digital Devices, FCC/OET TP-5*, known simply as *TP-5*, will replace the existing measurement rules, *MP-4*, adopted in 1983 (see *MWN*, S83).

Under the *TP-5* proposal, different procedures are specified for measurements of conducted and radiated emissions from tabletop devices and from floor-standing and other large digital devices.

The proposed changes were prompted in part by a 1987 petition from the Computer Business and Equipment Manufacturers Association (see *MWN*, M/J87 and S/O87). The FCC also notes the fact that the "computer industry has changed dramatically since 1980 in ways that affect how computers are tested." The notice of proposed rulemaking was released on March 7.

Recent FCC tests of digital devices found that a "significant percentage" of the equipment did not comply with the commission's RF emission limits. The FCC hopes that by providing additional guidance and clarification, the compliance rate will improve and that the new procedures will facilitate more efficient testing and reduced compliance costs.

Some people have argued that the FCC should go further and adopt the recommendations in *CISPR Publication 22* for controlling interference; a number of European countries have already done so. The FCC is requesting comments as to whether its emission limits and test procedures should conform to those of CISPR.

Comments are due by May 8 and reply comments by June 7. Contact: Hugh Van Tuyl or Richard Fabina, FCC Lab, 7435 Oakland Mills Rd., Columbia, MD 21046, (301) 725-1585.

U.S.S.R. Meetings on ELF, MWs and MM Waves

U.S. scientists have been invited to attend an international symposium on *The Fundamental Aspects of the Application of Millimeter-Range Electromagnetic Radiation in Medicine*, to be held in Kiev, U.S.S.R., May 10-13. The meeting is being organized by Professor S.P. Sitko; papers will be presented in Russian, Ukranian and English.

"This is the first time they have opened up this type of meeting to Americans," Dr. Om Gandhi of the University of Utah in Salt Lake City told *Microwave News*. He noted that, while work in this area has virtually ceased in the U.S., the Soviets are continuing their studies. "They continue to believe in frequency-specific effects of millimeter waves," he said.

Neither Gandhi nor Dr. Shirley Motzkin of the Polytechnic University in Brooklyn, NY, both of whom were invited to the Kiev meeting, has yet been able to secure travel funds. Without travel grants, both said that they will be unable to attend.

And next September 25-30, Soviet and U.S. scientists will meet in Uzhgorod in the Soviet Ukraine as part of a continuing U.S.-U.S.S.R. cooperation program. Workshops are held every two years (see *MWN*, M85 and J/A87).

According to Jack Monahan of the Center for Devices and Radiological Health at the Food and Drug Administration in Rockville, MD, the workshop will focus on biological effects at extremely low and microwave frequencies. Last year, Monahan took over as the U.S. coordinator of the U.S.-U.S.S.R. program from Dr. Don McRee, whose agency—the National Institute of Environmental Health Sciences—stopped sponsoring its own non-ionizing radiation research (see *MWN*, J/A87).

In addition to Monahan, those invited to attend the Uzhgorod workshop are: Drs. Larry Anderson, Carl Blackman, Reba Goodman, Bill Guy, Imre Gyuk, Henry Kues, Henry Lai, Mary Ellen O'Connor and Howard Wachtel.

EPA Measures RF Radiation in McFarland, CA

A preliminary analysis of measurements taken by a team from the Environmental Protection Agency (EPA) indicates that the primary source of ambient radiofrequency radiation in McFarland, CA, is UHF television signals, with a smaller contribution coming from the Voice of America (VOA) station in nearby Delano. The levels were in the nanowatt per square centimeter range.

Norbert Hankin and Ed Mantiply, both of EPA's Office of Radiation Programs, took extensive measurements in McFarland and in and around the Delano VOA station March 6-16, with the assistance of staffers from the VOA and from the National Telecommunications and Information Administration. A report is in preparation and should be available by late summer.

The EPA measurements were made at the request of the California Department of Health Services as part of its continuing effort to identify the cause of a cancer cluster among the children of McFarland (see *MWN*, J/F88 and S/O88).

ELF NEWS

« Power Line Talk »

The controversy continues over a power line built by the **Irish Electricity Supply Board** in County Wicklow. In January, the line was energized after the Minister for Energy, Michael Smith, received a report prepared by his chief technical advisor, Dr. Tom McManus, who found "no health risk on the basis of present knowledge." *Electromagnetic Fields from High Voltage Transmission Lines* concludes that, "There is no scientific basis at this time to justify a further delay to the energizing of the Carrickmines-Arklow 220 kV transmission line." The 35-mile power line, which reportedly cost £9.5 million (IR), is located near two schools (and many homes)—it replaces an existing 110 kV line along the same right-of-way. The November 1988 report notes that the calculated maximum magnetic fields near the two schools are approximately 20 and 40 mG; the calculated maximum electric field levels are less than 4 kV/m. Smith called for an independent assessment following protests from concerned county residents and a citizens' group called **SPARKS**—Stop Powerlines Across Residences, Kindergartens, and Schools (see *MWN*, S/O87). SPARKS's John Royds called the report a "whitewash" and in a letter to the *Irish Times* (February 7) rejected it because "it contains flaws, omissions and is biased." Royds questioned how the report can be "independent" when it was written by the minister's own advisor. SPARKS is preparing a detailed response to the report and, in the meantime, is fighting for the line to be "switched off during school hours as an interim measure." Copies of the report are available for £12 (IR), including shipping and handling, from: Government Publications Sales Office, Sun Alliance House, Molesworth Street, Dublin 2, Republic of Ireland. The check must be in Irish currency.

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The deadline for responses to the **National Cancer Institute**'s (NCI) requests for proposals (RFPs) for its study of the etiology of childhood cancer and EMFs has been extended. Proposals are now due by April 6. Meanwhile, the investigation into the possible ethical violations by NCI staffers testifying at power line hearings and trials continues.

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Through the years a number of people have speculated over a possible association between sudden infant death syndrome (**SIDS**) and EMF exposure. Recently, the ***Sunday Mirror***, a **British** tabloid, has turned the issue into a crusade featuring a series of articles on "cot death" and its link to power lines, radar and microwaves. The headlines have been sensationalistic: for instance, "Rays of Death: Electro Waves Clue to Cot Tragedy Babies" and "Meter Goes Haywire in New Tests." Roger Coghill and Dr. Cornelia O'Leary, both of Coghill Research Associates, a London-based consulting firm specializing in EM pollution, started the frenzy in January with seminars on "Electropollution: The Hidden Threat to the Planet." The *Sunday Mirror* reported that research has been ignored because the medical world is "too frightened of its implications." On January 29, the tabloid's reporter Paul Scott and Coghill blamed "a cluster of anguish" on radar radiation from the Farnborough Air Force Base. In a February 12 follow-up, Scott quotes Coghill: "The poor babies were bombarded with incredibly powerful electromagnetic waves. They didn't have a chance." The *Mirror*'s editors, believing they were on to something important, sent Scott and Coghill 6,000 miles to Rohnert Park (near Santa Rosa), CA, where there has been another cluster of SIDS cases. In a March 12 item, Scott dubbed the area "the electromagnetic capital of the world," and reported that, "Once again we have discovered important evidence that the babies were killed when they were exposed to dangerously high levels of magnetic waves." On February 19, the *Sunday Mirror* also reported that Lord **Laurence Olivier** had called in Coghill to test the bedroom of his eight-month-old grandson for electromagnetic waves. After being given the "all clear sign" by Coghill, Olivier said, "We must make sure that people like Mr. Coghill are given enough money to carry out this important work." According to the *Sunday Mirror*, Olivier is planning to come out of retirement to narrate a television series about the "harmful effects of the waves."

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Planners have joined the ranks of those concerned about potential EMF health effects. Joel Goldsteen, a city and regional planner at the University of Texas in Arlington, wants other planners to be aware of the potential public health hazard posed by power line EMFs. In the January 1989 issue of *Planning*, the journal of the American Planning Association, Goldsteen concludes—after plotting the paths of power lines in the Dallas-Fort Worth metropolitan area and taking into account statistics from recent research showing increased cancer risk among people living within 500 feet of high-voltage lines—that "some seven percent of the area's residents could at some point be negatively affected by the EMFs of overhead power lines." Goldsteen notes that some planners have promoted the idea of using power line rights-of-way as "parklike 'amenities.' " He suggests that, in the future, planners may have to employ environmental risk assessment methods, such as considering epidemiological studies on EMF-cancer risks, when siting new schools.

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On March 13, the entire **Hydro-Québec** power grid went down, knocking out electrical service to almost six million people and the Montréal subway system, according to the Associated Press. The power failure, which reportedly was triggered by a magnetic storm from a solar flare, was the third "province-wide" power failure this year. Some people blame the system's vulnerability on Hydro-Québec's large power sales to the northeast U.S.

Swedish Academy of Sciences To Review ELF Effects

The Royal Swedish Academy of Sciences has invited a group of international experts to Stockholm, May 25-27, to review the biological effects of extremely low frequency (ELF) fields. The objectives of the workshop are "to critically scrutinize possible mechanisms and to try to evaluate the significance of experimental findings," according to the academy.

Scheduled speakers at the meeting on *Interaction Mechanisms of Low-Level Electromagnetic Fields in Living Systems—Resonant Phenomena* include Drs. Ross Adey of the Veterans Administration in Loma Linda, CA, P. Bayley of the National Institute for Medical Research in London, U.K., Carl Blackman of the U.S. Environmental Protection Agency in Research Triangle Park, NC, Alessandro Chiabrera of the University of Genoa in Italy, Michel Coleman of the International Agency for Research on Cancer in Lyons, France, Carl Durney of the University of Utah in Salt Lake City, Reba Goodman of Columbia University in New York City, Yngve Hamnerius of the Chalmers University of Technology in Gothenburg, Sweden, Abraham Liboff of Oakland University in Rochester, MI, Robert Liburdy of the Lawrence Livermore Labs in Berkeley, CA, Herman Schwan of the University of Pennsylvania in Philadelphia and Bruno Zimm of the University of California at San Diego.

The meeting, which is by invitation only, will be chaired by Professor Claes Ramel of the academy's environmental committee. For more information, contact: Dr. Hans Lundberg, Environmental Secretary, Royal Swedish Academy of Sciences, PO Box 50005, S-104 05, Stockholm, Sweden, (46) 8-150430.

EPRI R&D Budget for EMFs: $21.9 Million for 1989-1991

The Electric Power Research Institute (EPRI) has increased its budget for research and development (R&D) on electromagnetic fields (EMFs) to $21.9 million for 1989-1991. EPRI has allocated $7.1 million for 1989, $7.6 million for 1990 and $7.2 million for 1991.

The institute's EMF budget is now more than twice the Department of Energy's (DOE) $3.0 million EMF bioeffects research budget for fiscal year 1989 (see *MWN*, S/O88). EPRI and the DOE are the primary sources of EMF research funds in the U.S.

Last year, EPRI predicted it would spend only $6.0 million in 1989 and 1990; the new budget represents an almost 20% increase (see *MWN*, M/A88). Of the $21.9 million, $16.4 million is for EPRI's Environment Division and $5.5 million is for its Electrical Systems Division.

The $21.9 million does not include funds for staff and support, according to EPRI's Dr. Stan Sussman. EPRI's total R&D budget for 1989-1991 is $865 million.

These statistics appear in *EPRI Research and Development Program 1989-1991*, which is available free to EPRI members, for $50 for others in the U.S. and for $70 outside the U.S. from: Susan Rapone, EPRI, PO Box 10412, Palo Alto, CA 94303, (415) 934-4212.

Review Finds "Consistency" to Cancer Risk in Epi Studies

There is a certain consistency to the observed link between exposures to electromagnetic fields (EMFs) and cancer in both residential and occupational epidemiological studies, according to Dr. Anders Ahlbom of the Swedish Institute of Environmental Medicine in Stockholm. The data "strongly suggest" the need for further research, he concludes.

Writing in the *Scandinavian Journal of Work and Environmental Health (14*, pp.337-343, 1988), Ahlbom presents the most detailed review to date of the nine published residential EMF epidemiological studies and finds that, "Given the different study designs, time periods and locales, the findings of the studies do appear to be rather consistent."

With respect to the ongoing debate on the use of wire codes to estimate residential EMF exposures, Ahlbom writes, "As long as the wire coding system is applied in the same way to cases and non-cases, any exposure misclassification can only mask a true effect; it cannot give rise to a spurious effect."

The results of the adult residential studies, when combined, do not provide much evidence for an association, he notes, but he adds that the residential studies "should be considered in tandem with the studies on occupational exposure, and when their results are combined, indeed, an association cannot be disproved."

Ahlbom takes a briefer look at the occupational studies, noting that the literature in this area has been reviewed "thoroughly by others." He concludes that, "Despite the obvious limitations of these studies and the somewhat erratic findings, it is difficult to avoid the conclusions that there is a certain consistency between the results and that it seems likely that these occupations are in fact at an increased risk of leukemia."

He cautions, however, that, based on current data, no conclusion can be drawn about the role of EMFs in the origin of cancer.

Ahlbom was a member of the advisory panel to the New York State Power Lines Project (see *MWN*, J/A87) and is himself directing an ongoing major epidemiological study on power line cancer risks in Sweden (see *MWN*, M/J87).

The contractors and their topics are: Dr. John Peters of the University of Southern California School of Medicine on epidemiological studies; Dr. Asher Sheppard of the VA Hospital in Loma Linda, CA, on lab data and biophysical models; Dr. Kurt Salzinger of the Polytechnic University in Brooklyn, NY, on behavioral effects; Dr. Kenneth Groh of the Argonne National Lab on circadian rhythms; Dr. Neil Chernoff of the Environmental Protection Agency on reproductive and developmental effects; Dr. William Feero of Electric Research and Management on exposure assessments; and Drs. Lee Rosen and William Wisecup of W/L Associates on programs and funding efforts worldwide. W/L Associates will also cover those research areas not addressed by the other reports.

In its report, the PUC will summarize the information supplied by the contractors and make recommendations with regard to future studies and the potential need for exposure guidelines, Murley said. The contractors' reports will be appended to the PUC report. In addition, the PUC has invited the Electric Power Research Institute to submit a report on its own research; it also will be appended to the PUC report.

This summer, the PUC will hold public meetings in San Francisco, Los Angeles and Sacramento, Murley said, adding that additional meetings may be scheduled if the need arises.

Planning is also underway as to which projects will be funded by the $2 million allocated for research on biological effects of power line fields.

Maryland: Experimental Research

The Department of Natural Resources is considering sponsoring laboratory research on power line EMFs, according to Thomas Magette of the department's Power Plant and Environmental Review Division in Annapolis. Magette, who is serving as the project manager, told *Microwave News* that the agency is "entertaining several proposals" for experiments using 60 Hz magnetic fields, but no decisions have yet been made.

The project, which is tentatively set to begin in the late summer or the early fall, is envisioned as a one-year study, but it may become an ongoing effort.

Virginia: Annual Report Issued

The Virginia Department of Health recently released its fourth annual report on power lines, which concludes that "recently published literature does not perspicuously demonstrate that exposure to electric and/or magnetic fields in the magnitude produced by high voltage transmission lines is causally associated with cancer or any other long-term detrimental effects in humans."

The 12-page report, *Monitoring of Ongoing Research on the Health Effects of High Voltage Transmission Lines*, prepared by the department's Dr. Khizar Wasti, presents an overview of relevant literature published in 1987-88, including, among others, Dr. David Savitz's childhood cancer study, Dr. Margaret Speers's occupational study of electrical workers and the World Health Organization's report on magnetic fields.

The reports are submitted annually to the Virginia General Assembly by order of state Senate Joint Resolution No.126, which was approved in 1985 (see *MWN*, J/F86). For more information, contact: Dr. Khizar Wasti, Bureau of Toxic Substances Information, Virginia State Health Department, 109 Governor St., Richmond, VA 23219, (804) 786-1763.

NY DOH on Electric Blankets

On February 9, the Fox Network's *Ten O' Clock News* ran a story on the potential risks of magnetic fields from electric blankets. The segment, which featured Dr. David Carpenter of the New York State Department of Health (DOH), referred people to the DOH for more information. The next day, according to Fox reporter Dr. Joanna Shaw, the DOH received over 350 telephone calls—prompting a followup story on Fox's February 10 broadcast. The following is an excerpt from a question-and-answer fact sheet which the DOH sent out to callers.

Q. Do electric blankets, or waterbed heaters, cause cancer?
A. No one knows for sure. Electric blankets, waterbed heaters and other electric appliances in the home give off magnetic fields. There have been some scientific studies which suggest—but do not prove—a link between some cancer and the magnetic fields coming from power lines. Some scientists suspect that home appliances could be hazardous in the same way.
Q. Do electric blankets produce large magnetic fields?
A. Yes. The magnetic field experienced by the human body under an electric blanket is approximately four times larger than that measured in the homes where higher cancer rates were associated with power lines in the street.
Q. Do blankets constantly expose people to magnetic fields?
A. No. The fields are only generated when appliances are turned on. Also, the strength of the field falls off rapidly with distance away from the appliances. Electric blankets, mattress pads and waterbed heaters create a lot of exposure because people often stay in close contact with them for a long time (all night).
Q. Should I stop using electric blankets? Waterbeds? Mattress pads?
A. Some people have done that. Others have not. That is a choice for individuals and families to make. The [DOH] is not making any official recommendations. People have to weigh the possible risks, the alternatives available, and any other factors which may be important to them. You may wish to use your electric blanket to warm your bed and then turn it off before getting in.
Q. What about the risk to pregnant women?
A. Developing fetuses are more susceptible to many environmental risks than are other persons. Women may wish to consider reducing their exposure to magnetic fields during pregnancy.

Power Line Actions Across the U.S.

All over the U.S., states are taking action to learn about the potential health effects of electromagnetic fields (EMFs) from power lines. At a time when Florida has adopted power line magnetic fields standards (see p.1), some state legislatures and agencies are simply asking for literature reviews. Others, such as California and Maryland, are being more ambitious and are funding their own laboratory studies. Below is a roundup of the latest actions from across the country.

Oregon: Strict EMF Limits Proposed

The Oregon Department of Human Resources (DHS) will have to adopt interim magnetic and electric field standards of 2 mG and 1 kV/m, respectively, for high-voltage power lines by December 1, 1989, if House Bill No.2932 is passed by the state legislature. Oregon currently has only an electric field standard of 9 kV/m.

The proposed magnetic field limit is the strictest ever proposed in the U.S.—it was adapted from a similar bill introduced in the Washington state senate earlier this year. The Washington bill has since been completely rewritten and all mention of EMF standards has been dropped (see below).

The Oregon House bill was introduced on February 23; a public hearing was scheduled for March 27. The bill is sponsored by Representative Nancy Peterson.

Among the bill's other requirements are that the DHS would evaluate the impact of EMFs on workers and on the environment and report back to the legislature by June 1990. The department would set up a panel to determine whether EMF exposures present an "unreasonable cancer risk." The panel would then submit a report describing the health risks associated with residential EMF exposures and listing high-priority research projects needed to better understand them.

At the same time that the state legislature is weighing action, the state Department of Energy is conducting its own EMF research review. David Stewart-Smith of the department's Nuclear Safety and Energy Facilities Division told *Microwave News* that he has put together a five-member panel to evaluate existing literature reviews. The panel will pass its findings on to the Energy Facilities Siting Council, an independent state agency which has the authority to set standards. Stewart-Smith said that the budget for the review is approximately $10,000-12,000.

Washington: Literature Review Sought

Senate Bill No.5275 would require a literature review of ongoing studies on EMF effects by the Washington State Institute for Public Policy, with the assistance of the Oregon Department of Energy. The bill, which would appropriate $10,000 for the review, calls for the institute to issue a report to the senate Committee on Energy and Utilities by December 1, 1989.

The senate approved the bill on March 8; it awaits action by the state assembly.

In its original form, the bill, which was sponsored by Senators Eleanor Lee and Phil Talmadge, sought the adoption of interim standards for power line EMFs as well as a study by a state epidemiologist of the impact of EMFs on workers and on the environment (see *MWN*, M/J88).

New York: Reducing EMFs

New York state utilities will soon complete plans for surveying EMFs around power lines and for developing ways of reducing the magnetic fields. The effort, which is being coordinated through the New York City-based Empire State Electric Energy Research Corp. (ESEERCO), is required by an April 1988 order from the NY Public Service Commission (PSC). It follows the recommendations of the PSC's EMF task force report, which in turn was prompted by the final report of the NY Power Lines Project (see *MWN*, M/A88).

The first phase of the project will be to characterize magnetic fields and then examine ways to reduce them. The next step will be to initiate projects to remedy problems identified in the first stage.

The survey data on 345 kV power line magnetic fields will be submitted to the PSC and will then be fed into a computer database. A technical conference, which was also ordered by the PSC last year, will be held this summer. The meeting will be open to the public, according to the PSC's Dan Driscoll.

Plan for Surveying Electric and Magnetic Fields from Overhead and Underground Power Lines in New York State and *Research Plan on Reducing Magnetic Fields Associated with Power Delivery and Use* will be published as one document and should be available by the end of April, ESEERCO's Herb Kaufman told *Microwave News*.

California: PUC Report Delayed

The Public Utilities Commission's (PUC) report on power line EMF effects, originally due on March 15, will now be submitted to the state legislature by September 15. Last year the legislature instructed the PUC and the state Department of Health Services to submit reports on "cancer and other medical risks which may be related to exposure to [EMFs] produced by electrical utility facilities" (see *MWN*, M/J88, S/O88 and N/D88).

Over the past six months, the PUC has hired seven contractors to submit eight reports on power line EMFs. The reports are costing the PUC $56,000. The money comes from the PUC's own budget, rather than from the $2 million allocated by the legislature for health research, the PUC's Clyde Murley told *Microwave News*.

HVDC Power Line and Agriculture Study: No Effects

There is "no evidence that a ±500 kV DC transmission line caused any effects on cattle or crops that would impact commercial farming or ranching operations," according to a new study sponsored by the Bonneville Power Administration (BPA) in Oregon.

While acknowledging that no single study can resolve all the questions about potential high voltage (HV) power line biological effects, the recently-released *Joint HVDC Agricultural Study* concludes that the results, taken with existing research, indicate that "it is unlikely that HVDC transmission lines cause adverse effects on plants, animals or people."

In one part of the Oregon project, 100 cows and six bulls were confined in pens directly under the line; the same number were kept in similar pens away from the line. No significant differences were observed in body weight, number of calves born or behavior—except that 1-4% fewer exposed cattle remained in areas directly under the line than in the corresponding areas in the control pens. The reason for this was not determined.

The three-year $1.7 million study at the Pacific Intertie power line was run by a team led by Robert Raleigh of Oregon State University in conjunction with the BPA, with assistance from the Electric Power Research Institute and from the Department of Energy. In addition, nine other utilities from around the country supported the project "because of renewed interest in the use of DC lines."

For more information, contact: Jack Lee, Project Coordinator, BPA, PO Box 3621–EFBG, Portland, OR 97208.

Also, Professors James Hornig and John Walsh, both at Dartmouth College in Hanover, NH, are working on a three-year, $400,000 project to study electric and magnetic fields and ion concentrations surrounding a new ±465 kV DC line which runs from Canada to Massachusetts. The state of New Hampshire is sponsoring the project. Hornig, a chemist, and Walsh, a physicist, will monitor the line for one year before and two years after the line is energized.

ELF and Power Line Resources

J.H. Bernhardt, "The Establishment of Frequency Dependent Limits for Electric and Magnetic Fields and Evaluation of Indirect Effects," *Radiation and Environmental Biophysics, 27*, pp.1-27, 1988.

The author, who is with the Institute for Radiation Hygiene in Neuherberg, F.R.G., and a member of IRPA's non-ionizing radiation committee, outlines a biophysical model—the basis for certain German standards—for determining EMF exposure limits for 50/60 Hz and higher frequencies. Direct and indirect EMF bioeffects are also discussed.

J.E. Deadman et al., "Occupational and Residential 60-Hz Electromagnetic Fields and High-Frequency Electric Transients: Exposure Assessment Using a New Dosimeter," *American Industrial Hygiene Association Journal, 49*, pp.409-419, August 1988.

Using the lightweight dosimeter developed by Hydro-Québec's IREQ (see *MWN*, S/O86), this team from McGill University and from Hydro-Québec measured significantly higher electric and magnetic field and high-frequency transient electric (HFTE) field exposures for utility workers than for those exposed to normal background fields—by a factor of ten for electric and magnetic fields and by a factor of 171 for HFTE fields. When weekly averages—combining work and non-work exposures—were compared, the differences were still significant, though smaller, for magnetic fields (a factor of 3.5) and for HFTE fields (a factor of 58).

William Feero, John Dunlap and James Yontz, "Magnetic Fields Remote from Substations," presented at the *Winter Meeting of the IEEE Power Engineering Society (PES)*, January 29–February 3, 1989 in New York City. A copy is available for $3.50 (members) and $6.50 (nonmembers) from: Single Publication Sales Dept., IEEE Service Center, 445 Hoes Lane, PO Box 1331, Piscataway, NJ 08855. Cite No.89WM096-9PWRD.

This study was prompted by public fears of health risks when Florida Power and Light Co. announced plans to build a new substation. The researchers found that the EMFs associated with substations decay quickly with distance—no fields could be detected 250 feet from the substation studied. Twenty feet from the fences of three similar 23 to 230 kV substations, the magnetic fields were less than 20 mG, often less than 10 mG, with the exception of transmission line entry and exit points.

Lita Furby et al., "Public Perceptions of Electric Power Transmission Lines," *Journal of Environmental Psychology, 8*, pp.19-43, 1988; and "Electric Power Transmission Lines, Property Values and Compensation," *Journal of Environmental Management, 27*, pp.69-83, 1988.

In the first article, the authors review and critique the literature on attitudes towards power lines, including such issues as health effects, property values and aesthetics. In the second, they concern themselves with current methods of determining the impact of power lines on land values and appropriate compensations to landowners for associated losses. The authors include Paul Slovic and Baruch Fischhoff, who are well-known for their studies on risk analysis.

N. Hayashi, K. Isaka and Y. Yokoi, "Analysis of Magnetic Field Profiles in Electric Blanket Users," presented at the *IEEE Power Engineering Society (PES) Winter Meeting*, January 29–February 3, 1989 in New York City. (See Feero et al. at left for ordering information; cite No.89WM100-9PWRD.)

Professor Isaka and coworkers at the University of Tokushima in Japan present calculations of magnetic fields from electric blankets, which agree reasonably well with measured values. Among their conclusions are that, "The separation between the body surface and

the blanket heating element is the most influential parameter on the magnetic field exposure," and that the maximum fields on the user's body surface range from 5 to 50 μT, depending on which component is measured.

Jukka Juutilainen et al., *Measurements of 50 Hz Magnetic Fields in Finnish Homes*, Helsinki, Finland: Imatran Voima Oy, 31 pp., 1989.

Juutilainen and coworkers at the University of Kuopio report that ELF magnetic fields from T&D lines "can increase the long-term average field levels in residences," but they warn that the increase was "found only in the immediate vicinity of external sources." Magnetic fields from appliances were "slightly lower," though "of the same order of magnitude," as reported in U.S. surveys—perhaps due to the different distribution voltages. They also found that higher magnetic fields were measured in rooms with electric underfloor heating.

Daniel Lyle et al., "Suppression of T-Lymphocyte Cytotoxicity Following Exposure to 60-Hz Sinusoidal Electric Fields," *Bioelectromagnetics, 9*, pp.303-313, 1988.

Lyle and coworkers at Dr. Ross Adey's lab in Loma Linda, CA, found a significant inhibition of cytotoxicity in T-lymphocytes following exposure to 10 mV/cm and 1.0 mV/cm electric fields and a non-significant inhibition at 0.1 mV/cm. These findings indicate a dose-response relationship and a threshold for the effect, and also point to a potential mechanism by which electric fields affect the function of the immune system.

Carl Maresh et al., "Exercise Testing in the Evaluation of Human Responses to Powerline Frequency Fields," *Aviation, Space and Environmental Medicine, 59*, pp.1139-1145, December 1988.

Eleven men in their 20s exposed to 60 Hz (9 kV/m, 16 A/m) fields for two hours had slower heart rates if they did not exercise first—there was no difference between exposed and controls if the exposure followed 45 minutes of exercise. The researchers are at the University of Connecticut and at the Midwest Research Institute (MRI). They include MRI's Harvey Cohen and Dr. Charles Graham.

Granger Morgan et al., *Electric and Magnetic Fields from 60 Hertz Electric Power: What Do We Know About Possible Health Risks?* Pittsburgh, PA: Carnegie Mellon University (CMU), 45 pp., 1989. Copies are available (prepaid) for $3.00 each for the first nine, $2.00 each for ten or more, from: Dept. of Engineering and Public Policy, CMU, Pittsburgh, PA 15213.

This brochure, written by Morgan's research group at CMU, is designed for the layperson. Using a question and answer format, it includes what is and is not known about health effects, especially cancer, and concepts of risk assessment; there is also a glossary.

Keith Petrie et al., "Effect of Melatonin on Jet Lag After Long Haul Flights," *British Medical Journal, 298*, pp.705-707, March 18, 1989.

After flying back and forth through 12 time zones over a period of three weeks, a group taking melatonin reported being less tired during the day and requiring less time to establish normal sleeping patterns than the control group. The researchers concluded that "melatonin can alleviate jet lag and tiredness after long haul flights."

Russel Reiter et al., "Reduction of the Nocturnal Rise in Pineal Melatonin Levels in Rats Exposed to 60-Hz Electric Fields in Utero and for 23 Days After Birth," *Life Sciences, 42*, pp.2203-2206, 1988.

Working with the Battelle team, Reiter found that rats exposed to electric fields of 10, 65 or 130 kV/m from conception to 23 days of age showed reduced peak nighttime pineal melatonin levels and shifts in circadian rhythms. No dose-response relationship was observed, however.

Martin Rosenthal and Günter Obe, "Effects of 50-Hertz Electromagnetic Fields on Proliferation and on Chromosomal Alterations in Human Peripheral Lymphocytes [HPLs] Untreated or Pretreated with Chemical Mutagens," *Mutation Research, 210*, pp.329-335, 1989.

Cultured HPLs exposed to 50 Hz 5 mT fields showed significant stimulation of the cell cycle progression, but no change in the frequency of sister-chromatid exchanges (SCEs) or chromosomal aberrations. In some cases, exposing HPLs pretreated with alkylating agents led to significantly higher frequencies of (SCEs). However, the authors reject the latter finding pending further studies.

O.C. Seevers, *Ground Currents and the Myth of Stray Voltage*, Lilburn, GA: The Fairmount Press, Inc., 211 pp., 1988, $44.00.

The author, a utility engineer for nearly 40 years who has a chatty writing style, presents detailed electrical calculations as well as data from actual court cases involving stray voltage and ground currents. The publisher entices readers with the following incentive: "How understanding stray voltage can help you avoid costly lawsuits."

Mike Silva et al., "Power Frequency Magnetic Fields in the Home," *IEEE Transactions on Power Delivery, 4*, pp.465-478, January 1989.

Describes extensive measurements of residential magnetic fields from external and internal (e.g., appliances) sources. One interesting finding: certain two-way switch wiring configurations for overhead lighting—producing a large overhead coil—generated magnetic fields up to ten times the typical mean values. The work was supported by EPRI.

Richard Wurtman and Judith Wurtman, "Carbohydrates and Depression," *Scientific American, 260*, pp.68-75, January 1989.

The Wurtmans address mood and appetite disorders, including seasonal affective disorder (SAD) and, along the way, review the roles of serotonin and melatonin.

Xiao-lin Xi and Granger Morgan, "Energizing China: First Itself, Next the World," *IEEE Spectrum*, pp.59-63, March 1989.

An overview of the electric power industry in the People's Republic of China today.

UPDATES

BIOLOGICAL EFFECTS

More Harm Than Good... Miniature radio transmitters which are strapped onto spotted owls to track their movements may be harming, rather than helping, the birds. According to a February 20 report by the Associated Press (AP), 37 out of 48 owls fitted with the transmitters, which weigh approximately 20 grams, died in the first year of study. Some experts contend that the spotted owls, which live in the northwest U.S., are an endangered species. Although one Fish and Wildlife Service biologist attributes the deaths to "predations and starvation," another points out that the devices have been shown to affect other birds, though there is no evidence of a similar effect on spotted owls, the AP reports. Both experts recommend further study.

COMPATIBILITY & INTERFERENCE

Assessing EEDs... Two staffers at the NIST (NBS) in Boulder, CO, have come up with a new method for characterizing the response of electro-explosive devices (EEDs) to pulsed EMFs: using a combination of statistics and thermodynamics to determine the probability that an EED will be detonated when excited by a pulse of a given width and amplitude. John Adams and Dennis Friday, whose study appeared in the November 1988 *IEEE Transactions on Electromagnetic Compatibility*, claim that their approach is both "more general and more efficient than previous methods used for EED assessment."

GOVERNMENT

Q's & A's on RF Bioeffects... The FCC has issued the third edition of *Questions and Answers about Biological Effects and Potential Hazards of RF Radiation*, OET Bulletin No.56. The 18-page report provides answers to some basic questions, such as: What is RF radiation? How is it used? How is it measured? What are its biological effects? What are safe exposure levels? Also addressed are specific RF sources: TV and radio broadcast towers, MW point-to-point relays, cellular and cordless phones and satcom stations. The bulletin is available from: National Technical Information Service, Springfield, VA 22161, (800) 336-4700 for $13.95. Order No. PB89-165286.

Committee Openings... The FDA is seeking nominations to fill five vacancies on its Technical Electronic Product Radiation Safety Standards Committee (TEPRSSC) at the end of 1989. The TEPRSSC addresses devices which emit either ionizing or non-ionizing radiation. The openings are for two members from the general public, two members from government (federal or state) agencies and one member from "affected industry." Applicants must have scientific or engineering training or equivalent experience. Send nominations to: Arlene Underdonk, Office of Standards and Regulations (HFZ-83), CDRH, 5600 Fishers Lane, Rockville, MD 20857.

MEASUREMENT

Briefs... Robert Clarke gives some pointers on "Picking an EMI Test Lab" in the January 1989 issue of *Test & Measurement World*. He advises some caution: "Choose your EMI lab with the same care that you would use in choosing a doctor." The article includes a survey of the leading labs with a listing of the services offered by each....The NIST (NBS) has signed an agreement with the Standards Council of Canada (SCC) that provides for mutual recognition of testing labs accredited by the NIST's NVLAP program and by the SCC's National Accreditation Program for Testing Organizations. The agreement is in accordance with the U.S.-Canada free trade pact, which went into effect on January 1, 1989. The pact with Canada follows similar arrangements with the U.K., Australia and New Zealand....Holaday Industries has released a new 18-page catalogue of its RF/MW meters and its instruments that measure EMFs from VDTs and power lines. Contact: Holaday Industries, Inc., 14825 Martin Dr., Eden Prairie, MN 55344, (612) 934-4920....Electro-Metrics has introduced a new portable hand-held EMI test receiver, the EMC-P80, for measurements in the 2-34 MHz band. The unit, which costs $4,995, is ideal for tracking down radiated interference sources. The company is also now marketing a receiver for TEMPEST testing in the 20 Hz to 50 kHz frequency range. The TTR-51L costs $19,950. Contact: Electro-Metrics Marketing Dept., 100 Church St., Amsterdam, NY 12010, (518) 843-2600.

New from the NIST... The NIST has issued two new reports. *Generation of Standard Electromagnetic Fields in a TEM Cell*, Technical Note 1319, by Dr. Motohisa Kanda and David Orr, details the pros and cons of the TEM—transverse electromagnetic—cell, which was developed at the NIST. It includes copies of some key papers on the use of TEM cells published over the last few years. A copy is available for $12.00, prepaid, from: Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Order No.003-003-02898-3....NIST's Electromagnetic Technology Division has a prolific staff. Mary DeWeese has compiled *Metrology for Electromagnetic Technology: A Bibliography of NBS Publications*, NBSIR 88-3097, which lists its publications (1970-1988) on optical electronics, cryoelectronics and superconductivity. It is a companion to an earlier volume listing publications of NIST's Electromagnetic Fields Division (see *MWN*, J/A86). The new bibliography is available for $15.95, prepaid, from: National Technical Information Service, Springfield, VA 22161. Order No.PB88-123682.

MEDICAL APPLICATIONS

AMA on PEMF Stimulation...A majority of a panel of experts assembled by the American Medical Association (AMA) has deemed that PEMF stimulation for the treatment of nonunion fractures is safe, but also that it has not yet been

shown to be effective. In a "Diagnostic and Therapeutic Technology Assessment" published in the February 10, 1989 issue of the *Journal of the American Medical Association*, the panel concluded that more well-controlled clinical trials are needed to establish efficacy: "Many [panelists] believed that the lack of controlled clinical trials compromised a thorough evaluation of the effectiveness of the treatment." Some promising results on a double-blind study of delayed fractures of the tibia may soon change this assessment. In a paper presented at the *101st Annual Meeting of the American Orthopaedic Association* in Hot Springs, VA, June 20-23, 1988, Dr. William Sharrard, based at Royal Hallamshire Hospital in Sheffield, U.K., reported a statistically significant enhanced union when treated with PEMFs. This finding is in contrast to preliminary results of a double-blind study—published in 1984 by Sharrard and others—indicating that nonunion fractures healed as well by immobilizing them as by treating them with PEMFs (see *MWN*, Ju84).

MEETINGS

Statisticians & EMFs... The *8th Conference on Radiation and Health of the American Statistical Association (ASA)*, July 9-13, will be devoted to "Health Effects of Electric and Magnetic Fields: Statistical Support for Research Strategies." Attendees at the meeting, which will take place in Copper Mountain, CO, will hear from Drs. Dan Bracken, a consultant, Leeka Kheifets of EPRI, Granger Morgan of Carnegie Mellon University, Charles Poole of Epidemiology Resources, Inc., Lee Rosen of W/L Associates, Mays Swicord of the FDA, Thomas Tenforde of Battelle and Gillis Theriault of McGill University, among others. For more information, contact: Marilyn Humm, ASA, 1429 Duke St., Alexandria, VA 22314, (703) 684-1221.

ELF and Power Line Sessions... More and more organizations are putting EMFs on their meeting agendas....The *35th Annual International Education Seminar of the International Right of Way Association*, June 18-22, will feature Harris Levin of Houston Light & Power on EMFs in the courtroom, as well as a question and answer panel on EMFs....At the *5th Annual Symposium of the Electromagnetic Energy Policy Alliance (EEPA)*, April 12-14, a panel of speakers from the EMF community will address the subject of "Electricity: Is There a Risk?" AT&T Bell Labs' Ron Petersen and Dr. Max Weiss will be the session co-chairmen. Also on the EEPA's agenda is a workshop on litigation, legislation and education, featuring Tom Watson of Crowell & Moring, who is involved in many power line cases around the country, and Gary Sazer of Parker, Chapin, Flattau & Klimpl, who is counsel to the Long Island Association, which is seeking to overturn New York's Suffolk County VDT law....At the *13th Annual Meeting of the American Society of Preventive Oncology*, March 20-21, Battelle's Dr. Richard Stevens will speak on electric power and breast cancer risk....And at the *51st Annual Meeting of the American Power Conference*, April 24-26, G.B. Johnson and B.A. Clairmont, both of General Electric Co., who are at the EPRI High Voltage Transmission Research Center in Lenox, MA, will present a paper on "Measurements of AC and DC Field and Corona Effects in a Hybrid Corridor."

Zurich EMC Meeting... The *8th International Zurich Symposium and Technical Exhibition on EMC* was held March 7-9 in Switzerland. Among the 115 papers presented were a report from Japan on the global distribution of power line harmonic radiation based on satellite data, a report from The Netherlands on methods of protecting electronic equipment against EMI—including testing in high-voltage substations—and a report on a new F.R.G. procedure to establish safe distances between RF sources and electro-explosive devices. For more information, contact: Professor T. Dvorák, EMC Symposium & Exhibit, ETH-Zentrum - IKT, 8092 Zurich, Switzerland, (1) 256-2788.

MW Weapons... The *7th DOD Conference on Directed Energy Weapon Vulnerability, Survivability and Effects* will be held at the U.S. Naval Postgraduate School in Monterey, CA, May 9-12. Dr. T. Wieting of the Naval Research Lab will give an overview of high power microwaves (HPMs); Dr. H. Cabayan of Lawrence Livermore National Lab will discuss the susceptibility of U.S. systems to RF radiation; Howard Bassen of the Walter Reed Army Institute of Research will review the Army program on HPM bioeffects; and a team from Los Alamos National Lab will describe progress on explosion-driven HPM weapons research under the high-intensity single pulse source program. There will be additional presentations at the meeting, which is classified Secret. For more information, contact: Donna Richard, Booz, Allen & Hamilton, Inc., 1300 N. 17th St., Suite 1610, Rosslyn, VA 22209, (703) 527-5429.

MILITARY SYSTEMS

EIS on USAF Transmitter Site... The USAF has announced that it will prepare an environmental impact statement (EIS) for the planned Northeast Regional Communications Facility (NRCF) in the Pine Barrens near Warren Grove, NJ. The decision to prepare the EIS followed pressure from the NJ governor, NJ's Congressional delegation and the state legislature—all oppose building the 18 towers, which would range in height from 100 to 221 feet, in an environmentally sensitive area, according to the February 22 *Philadelphia Inquirer*. In 1985, the USAF also met intense opposition when it proposed building the NRCF in Hawley, MA (see *MWN*, J/A85); it later abandoned its plans for that site. For more information, contact: Richard DiCamillo, HQ USAF/PRPJB, Pentagon Room 5C966, Washington, DC 22030.

OVENS

More on Incomplete Cooking... Experts continue to warn consumers that food cooked in a MW may still harbor parasites and bacteria due to incomplete or uneven heating (see

MWN, Ju81, A82 and S/O88). Tests at the Institute of Food Research in Norwich, U.K., showed that a stuffed chicken treated with bacteria had viable bacteria after MW cooking. In order to prevent bacterial survival, the researchers recommend that food cooked (and reheated) in a MW reach a uniform temperature of 70°C. In a letter published in the January 28 *Lancet*, they advise letting food stand after cooking "to allow the heating to be evenly distributed by conduction without overcooking."...In a related study appearing in the *Journal of Microwave Power and Electromagnetic Energy (23*, pp.183-194, 1988), Wen Lin and Dr. Carol Sawyer, both of the Department of Food Science and Human Nutrition at Michigan State University in East Lansing, report that wrapping meat loaf in polyvinylidene chloride film prior to MW cooking resulted in the survival of fewer anerobic bacteria.

Consumers Union Ratings... In the March 1989 issue of *Consumer Reports*, Consumers Union (CU) evaluates over 50 midsize MW ovens for efficiency, price and MW radiation leakage, among other criteria. According to CU, all of the ovens tested were "well within the U.S. Bureau of Radiological Health's [BRH] standard" for leakage (BRH is now known as the Center for Devices and Radiological Health). CU cautions, however, that any oven that has been damaged —from a fire, from a "serious overheating incident" or from having been dropped—may have a warped or misaligned door, which increases the likelihood of greater leakage. "If there's any doubt about the oven, have it checked by a qualified professional," the group advises. CU also notes the potential hazards associated with MW heat susceptors—metalized films and coatings used in packaging to concentrate heat for browning and crisping—and the FDA's concern that the high temperatures created by the susceptors might cause chemicals in the packaging to "contaminate" food. In addition, plastic wraps, when overheated, can leach chemicals into food. CU suggests that if you use plastic wraps for MW cooking, avoid their direct contact with food and poke holes in the plastic to release steam.

Florida Magnetic Field Standards *(continued from p.1)*

Tarpon-Kathleen line—are not giving up their fight for protective standards. The county attorney has issued a challenge to the rules, citing, among other issues, concern about potential health risks.

For magnetic fields, the maximum levels are 150 mG for lines of 230 kV or less and 200 mG for 500 kV lines; for certain double-circuit 500 kV lines, the limit is 250 mG (see table below). In contrast, in June 1988, the DER proposed *daily average* and *maximum* magnetic field levels of 50 mG and 100 mG, respectively. "We dropped the daily average standard, because it would be too hard to verify," Oven said.

For electric fields, the new standard is 2.0 kV/m at the edge of the right-of-way (ROW). The earlier proposed limit was 1.5 kV/m.

Under the new regulations, the 500 kV Lake Tarpon-Kathleen power line must comply with limits negotiated by the state Siting Board and the Florida Power Corporation (FPC) during the line's certification process last spring: the magnetic field limits are a *daily maximum* of 35 mG and 24 mG under normal load conditions where the ROW is 100 feet and 190 feet, respectively. (Under load conditions exceeding 500 MW—allowed no more than 15 hours a year—the *maximum* levels are 229 mG at the 100-foot ROW and 154 mG at the 190-foot ROW.) Since the 500 kV line will only operate at 16% of its capacity, according to Oven, the limits are also based on a "technologically achievable" level.

In a March 22 petition, County Attorney Frederick Karl, representing Hillsborough County, argued that the rules "arbitrarily" separate power lines into three categories—existing lines, new lines and the Lake Tarpon-Kathleen line—and that they contain "substantive and material changes" from the way the rules were originally drafted. Furthermore, Karl charges

Florida's Standards for Maximum 60 Hz Electric and Magnetic Fields

	Type of New Power Line			
Type of Field	≤230 kV	500 kV	500 kV (double circuit)*	Proposed Levels†
Magnetic (edge of ROW)	150 mG	200 mG	250 mG	100 mG
Electric (edge of / on ROW)	2 / 8 kV/m	2 / 10 kV/m	2 / 10 kV/m	1.5 kV/m

* Special exceptions apply.

† The DER proposed these levels in June 1988. A daily average magnetic field limit of 50 mG was also proposed.

that the Environmental Regulation Commission "failed to consider all of the scientific evidence available" in promulgating the rules and that the rules "conflict with the Resolution passed the same day" which cites potential public health risks from power line EMFs (see box below). "Our position is that the standards are not protective of public health," Chief Assistant County Attorney Elliott Dunn told *Microwave News*. Dunn added that the county attorney's office became involved following an appeal from Hillsborough citizens to "keep up the fight" and challenge the rules.

The DER's decision to relax the proposed standards was prompted, in part, by data showing that seven out of ten 500 kV lines operating in the state can meet the 200 mG limit, Oven explained. Last year, Oven told *Microwave News* that the vast majority of the state's existing 500 kV lines did not conform to the proposed 50-100 mG levels, nor did more than half of the existing 230 kV lines (see *MWN*, M/J88). He pointed out that even some of the 138 kV lines could not comply.

The maximum magnetic field level for 230 kV lines, which was also raised to 200 mG, was later reduced to 150 mG because of complaints from residents that a 200 mG standard would be too lax for smaller lines, Oven said. The 150 mG limit—which was proposed and then adopted at the January 18 hearing—is "basically a compromise" between what the utilities asked for and what the citizens wanted, he said.

For a history of the Florida rulemaking effort, see *MWN*, J/A83, J/A84, M/A86 and N/D87.

Florida DER–ERC Resolution

1. WHEREAS, the Environmental Regulation Commission [ERC] of the State of Florida Department of Environmental Regulation [DER] on January 18, 1989, adopted standards and requirements to reasonably protect the public health and welfare from electric and magnetic fields generated by transmission lines; and

2. WHEREAS, the Commission based its decision on a thorough review of present scientific data on the potential health effects of electric and magnetic fields, wherein it found that although there is no conclusive evidence that there is any danger or hazard to public health at the levels of existing 60 Hz electric and magnetic fields found in Florida, there is evidence of a potential for adverse health effects on the public, with further research being needed to determine the extent of the effects and the exposure levels at which the effects occur; and

3. WHEREAS, the Commission further based its consideration on the recommendations of the Department's EMF Advisory Panel, which recommended, among other things, that it would be prudent to keep the long-term exposure of the population to low values, by so far as possible routing transmission lines outside of residential areas and, where this is not possible, to limit the magnetic and electric field strengths at the edge of the right of way.

NOW, THEREFORE, be it resolved:

1. The [ERC] encourages new electric transmission lines of 69 kV or greater to be sited in a manner that will consolidate such lines within existing corridors and that new corridors should be planned in coordination with land use plans of local governments in order to attempt to avoid placing corridors through residential areas.

2. This resolution shall be furnished to all local governments, Regional Planning Councils, and electric utilities in the state to assist their land use and siting plans.

RESOLVED before the [ERC] in Tampa, Hillsborough County, Florida, this 19th day of January, 1989.

Robert A. Mandell, Chairman

NAS-NRC on ELF Mechanisms *(continued from p.1)*

the epidemiological studies as "interesting, but inconclusive," and Dr. Roy Shore advised that, "We need stable results that can stand up to scrutiny."

A number of experiments "beg replication," Shore said. But he added that there are limits to how much can be derived from further epidemiological studies and that if he had a budget of $10 million, he would spend it on good animal studies.

Like Heath, Setlow characterized the epidemiological literature as "interesting, but not convincing." With respect to the need for mechanisms, he said that, "If the data were stronger, there would be less need for mechanisms; when it is weaker, you look for mechanisms." Overall, he said that progress has been made in the field since the last academy meeting in 1985 (see *MWN*, N/D85 and M/J86). Setlow, the associate director of life sciences at the Brookhaven National Lab on New York's Long Island, has a background in both physics and biology.

Dr. David Carpenter, one of the invited speakers, argued that, from a public health point of view, "There is a certain urgency" for sponsoring a "serious and forceful investigation," even though "we are a long way from understanding mechanisms." He said that animal studies were needed to find out more about the risks of brain cancer and leukemia associated with ELF exposure.

Carpenter and Dr. David Savitz, who reviewed the epidemiological literature for the panel, both warned that if there is indeed a cancer risk, the available data would tend to underestimate it because of the poor dosimetry used in past studies.

A report will be prepared by the panel, according to Dr. Ray Cooper of the NAS-NRC's Board on Radiation Effects Research, who organized the workshop. Setlow predicted that the board will hold regular biennial briefings on nonionizing radiation in the future.

Members of the NAS-NRC panel are: Drs. Richard Setlow, chairman, Brookhaven National Lab; Clark Heath, American Cancer Society; Robert Pound, Harvard University; Regina Santella, Columbia University; Herman Schwan, University of Pennsylvania (emeritus); Roy Shore, New York University Medical School; and Eugene Stanley, Boston University. The invited speakers were: Drs. Martin Blank, Columbia University; Craig Byus, University of California, Riverside; David Carpenter, New York State Department of Health; Russel Reiter, University of Texas, San Antonio; David Savitz, University of North Carolina, Chapel Hill; and Tom Tenforde, Battelle Pacific Northwest Labs.

COMMENTARY

How *Not* To Revise the 1982 ANSI RF/MW Radiation Limits

This summer, the Bioelectromagnetics Society (BEMS) will present its highest honor, the D'Arsonval Award, to Dr. Ross Adey for his work on weak electromagnetic fields and their non-thermal effects. Although Adey won the support of the leaders of the society, not everyone is pleased. Dr. Eleanor Adair, for one, has resigned from the BEMS Awards Committee, charging that the decision will be an "embarrassment" to the society and that "his selection both demeans the award and denigrates the society." Many members of BEMS are astonished by Adair's charges.

Adair's work is on thermal physiology and she may have doubts about the existence of electromagnetic effects that have nothing to do with heating—she favored giving the award to Dr. Sol Michaelson, a loyal member of the thermalist school.

All this would only be a bad case of sour grapes if it did not raise serious questions about Adair's new role as co-chair, with Dr. Om Gandhi, of the subcommittee which is revising the 1982 American National Standards Institute (ANSI) limits for exposure to radiofrequency and microwave (RF/MW) radiation. In the absence of federal standards from the Environmental Protection Agency (EPA) or from the Occupational Safety and Health Administration, the ANSI limits have become the *de facto* U.S. standards and millions of Americans depend on them for protection at home and on the job.

The Adair-Gandhi subcommittee has now endorsed using a specific absorption rate (SAR) of 4 W/Kg as the threshold for ill effects in the revised standard—the same level as was used in 1982. In a February 2 letter to Dave Janes of the EPA, Adair wrote that she and Gandhi "agree that no further evaluation of the literature database is required to confirm the 4 W/Kg criterion."

The 4 W/Kg threshold was derived from studies by the U.S. Navy on behavioral disruption, according to Adair. On hearing this, EPA's Dr. Joe Elder responded that 4 W/Kg can *kill* an animal; he pointed out that SARs of 3.6 W/Kg are known to kill rats in a little over two hours. It is true that fur-bearing animals have different thermal regulatory systems than humans, but Elder also noted that rhesus monkeys experience "marked hyperthermia" at SARs of greater than 3.4 W/Kg and cannot tolerate SARs of more than 5.1 W/Kg for more than ninety minutes. He urged the subcommittee to "accept the dose rate of 4 W/Kg as the adverse effect level based on lethality in laboratory animals."

To be sure, ANSI builds in a safety factor—the 1982 exposure limits are based on an SAR of 0.4 W/Kg. But if 4 W/Kg can kill, what can the radiation do in more subtle ways and how much protection is warranted?

By retaining a 4 W/Kg limit, Adair and Gandhi appear to be disregarding a whole body of work that has appeared since 1982. The research is on both thermal and non-thermal effects and it indicates that 0.4 W/Kg is not protective.

In addition, there is no evidence that the subcommittee has ever discussed the potential RF/MW cancer risk—the subject of an ongoing EPA investigation.

With respect to thermal effects, EPA's Dr. Christopher Gordon has argued that when scaling from one species to another, differences in surface area are more important than differences in weight. According to Gordon's calculations, safety levels would have to be tightened by a factor of nearly ten to protect against the greater thermal insult.

When we reported Gordon's thesis two years ago, we quoted Elder as saying, "I expect there will be a lot of discussion of Gordon's paper in the bioelectromagnetics community" (see *MWN*, J/A87). This has not happened. That Adair has rejected Gordon's position is her prerogative, but she should nevertheless be encouraging a debate, not stifling one.

On the non-thermal front, the findings of Henry Kues of the Johns Hopkins University Applied Physics Lab and Jack Monahan of the Food and Drug Administration have serious implications: they have shown that pulsed microwaves can cause leakage in the blood-eye barrier of a monkey at an SAR as low as 2.6 W/Kg. When the eye is treated with glaucoma medicine the threshold is lowered to 0.26 W/Kg. How ANSI takes into account such synergy will be important to the more than two million Americans who use glaucoma drugs (see *MWN*, S/O86, J/A87 and J/A88).

The fact that the latest Kues-Monahan findings have not yet been published—the manuscript is in final editing—is immaterial. Both researchers are respected members of BEMS and they have presented a steady stream of results at the annual meetings. There is no doubt that the work is germane to health standards, so why is ANSI ignoring it?

Adair fears that giving the D'Arsonval Award to Adey will reflect badly on BEMS. This is nonsense. A much more important concern is how Adair's and Gandhi's actions on the ANSI standard will reflect on the bioelectromagnetics community if they fail to apply available knowledge to protect public and occupational health.

The "Commentary" column will be a regular feature in Microwave News. *We invite our readers to write to us with their opinions.*

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CONFERENCES

New Listings

May 9-12: **7th DOD Conference on Directed Energy Weapon Vulnerability, Survivability and Effects,** U.S. Naval Postgraduate School, Monterey, CA. Contact: Donna Richard, Booz, Allen & Hamilton, Inc., 1300 N. 17th St., Suite 1610, Rosslyn, VA 22209, (703) 527-5429 (see p.12).

May 16-18: **8th Annual Conference on Properties and Applications of Magnetic Materials,** McCormick Centre Hotel, Chicago, IL. Contact: Prof. Messinger, Dept. of Electrical and Computer Engineering, Illinois Institute of Technology, 3301 S. Dearborn St., Chicago, IL 60616.

May 25-27: **Interaction Mechanisms of Low-Level Electromagnetic Fields in Living Systems–Resonant Phenomena,** Stockholm, Sweden. Contact: Dr. Hans Lundberg, Royal Swedish Academy of Sciences, PO Box 50005, S-104 05, Stockholm, Sweden, (46) 8-150430.

June 21: **Annual Meeting of the Society for Light Treatment and Biological Rhythms,** National Institutes of Health, Bethesda, MD. Contact: Dr. Daniel Kripke, Veterans Administration Medical Center V116A, 3350 La Jolla Village Dr., San Diego, CA 92161, (619) 453-7500, ext. 3436.

July 9-13: **8th Conference on Radiation and Health of the American Statistical Association (ASA),** ***Health Effects of Electric and Magnetic Fields: Statistical Support for Research Strategies,*** Copper Mountain Conference Center, Copper Mountain, CO. Contact: Marilyn Humm, ASA, 1429 Duke St., Alexandria, VA 22314, (703) 684-1221 (see p.12).

September 20-22: **Symposium on Antenna Applications,** Allerton Park, Monticello, IL. Contact: Y.T. Lo, Dept. of Electrical and Computer Engineering, University of Illinois, 1406 W. Green St., Urbana, IL 61801, (217) 333-0293.

September 21-22: **39th Annual Fall Broadcast Symposium,** Hotel Washington, Washington, DC. Contact: Dr. Philip Rubin, Rubin, Bednarek Associates, 1667 K St., NW, Washington, DC 20006.

October 9-10: **21st Annual North American Power Symposium,** University of Missouri-Rolla, Rolla, MO. Contact: Dr. Charles Gross, Electrical Engineering Dept., Auburn University, Auburn, AL 36849, (205) 887-1812.

November 9-12: **11th Annual International Conference of the IEEE Engineering in Medicine and Biology Society,** Seattle, WA. Contact: Francis A. Spelman, Regional Primate Research Center SJ-50, University of Washington, Seattle, WA 98195, (206) 543-0440.

December 4-6: **International Conference on Magnetism and Magnetic Materials,** Rimini, Italy. Contact: Magis International S.r.l., Via Boccaccio, 19, 20123 Milan, Italy.

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January 3-5: **3rd International Interdisciplinary Research Conference on Fundamentals of Bone Growth: Methodology and Applications,** Los Angeles, CA. Contact: Dr. Andrew Dixon, Schools of Dentistry and Medicine, 63-090 CHS, University of California at Los Angeles (UCLA), Los Angeles, CA 90024, (213) 825-1761.

May 7-10: **IEEE 1990 International Radar Conference,** Marriott Crystal Gateway Hotel, Arlington, VA. Contact: Robert T. Hill, ITT Defense, 1000 Wilson Blvd., 30th Fl., Arlington, VA 22209.

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New Listings

Are Brain Tumors Markers for EMF Exposure?

Two new epidemiological studies add to the growing evidence of a link between electromagnetic field (EMF) exposures and brain tumors. In one case, on-the-job EMF exposures were again identified as a risk factor for brain tumors and, in the other, occupational EMF exposures were associated with brain cancer among workers' children.

There are now at least 12 studies pointing to an EMF-brain tumor risk (see table on p.15). "There are far too many positive studies to dismiss an EMF-brain tumor connection," Dr. Samuel Milham, Jr., told *Microwave News*. "It is as important to have a number of studies showing a positive effect as it is to have one large study," he added. Milham was one of the first researchers to identify brain tumors as an EMF risk factor.

Much of the EMF-cancer research has focused on leukemia as the major risk, but some researchers believe that the brain tumor link is more persuasive. Dr. Nancy Wertheimer said, "I definitely feel the case has always been the most consistent for brain tumors. The focus on leukemia was not warranted by the data."

(continued on p.14)

RF/MW Radiation Stimulates Human Brain Tumor Cells
A new study shows that brain tumor cells continue to proliferate at an abnormally high rate five days afer a two-hour RF/MW exposure. See p.5.

New Research Funding Proposals Emerge at Congressional Hearing

Support is growing for a significantly larger federal power line research program. At a March 8 congressional hearing, two congressmen said that they will seek funding increases, and a utility spokesman proposed an industry-funded, government-run effort modeled on the New York Power Lines Project (NYPLP).

Rep. Peter Kostmayer (D-PA), who convened the hearing as chairman of the House Interior Subcommittee on General Oversight and Investigation, called for a "doubling or tripling" of the current federal power line electromagnetic field (EMF) research budget of $3 million. "We are not talking about a lot of money when tens of millions of people may be protected as a result," he said. "The health impact of EMFs may very well be the most overlooked environmental hazard of the decade."

A second congressional proposal surfaced from Rep. Frank Pallone

(continued on p.7)

« Power Line Talk »

All those involved in the **Johns Hopkins University** (JHU) study showing higher cancer rates among NY telephone cable splicers say the work should be continued, yet the JHU team is less than confident that the necessary funding will be available. Following Drs. **Genevieve Matanoski** and **Patrick Breysse**'s announcement at last November's DOE-EPRI review (see *MWN*, N/D89), a peer advisory committee, assembled by **EPRI** to review the JHU team's original national case-control study, commented on the limitations of the NY incidence study as well. Breysse told us that the committee had concerns that an expansion of the study—even a doubling—would not yield meaningful results because the number of cases would still be too small. The committee—Drs. **Patricia Buffler, Philip Cole** and **Carl Shy**—encouraged the JHU team to develop a full research protocol and to seek funding, according to Buffler, who told us that, "We thought it was important that the questions be resolved." EPRI's Dr. **Leonard Sagan** appears to want to settle those issues as well. In the January/February issue of the *EPRI Journal*, he said that, "From the information we have seen...this clearly deserves to be followed up. EPRI intends to pursue possibilities for further research in this area with Dr. Matanoski to clarify the apparent differences in results." Although EPRI asked the JHU team to submit a funding proposal (EPRI did not pay for the NY study), Breysse said that EPRI does not appear to be too "enthusiastic." For the time being, the JHU team is finishing the case-control study before returning to the NY linemen project. "We're committed to expanding the incidence study. Our challenge will be to address the valid criticism of 'small numbers'," he said. The team is also looking around for other funding sources.

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The earth moved on February 28 when *New Yorker* writer **Paul Brodeur** and EPRI's Dr. **Leonard Sagan** went head-to-head in Santa Barbara before the California Municipal Utilities Association—in the middle of Brodeur's remarks, there was an earthquake (5.5 on the Richter scale). "I didn't realize EPRI was so powerful," Brodeur quipped. One observer, Cyrus Noë, the editor of *Clearing Up, Northwest Energy Markets*, summed up the debate this way: "Brodeur was appearing before a municipal utility audience that was not particularly sympathetic to his point of view, but despite that home-floor handicap, he beat Dr. Sagan 15 ways from Sunday. Brodeur had passion and outrage, Sagan had colored slides." The EMF issue is hot in Santa Barbara because of an unexplained childhood **cancer cluster** at the Montecito Union School. Between 1981 and 1988, there were six cases of leukemia and lymphoma among the students—five times the expected rate. Of particular concern is the fact that two 66 kV power lines are on the perimeter of the school property. In addition, there is an electrical substation close by. The day after the Brodeur-Sagan face-off, **Jack Sahl** of Southern California Edison told the *Santa Barbara News-Press* that, based on his EMF survey, "Montecito looks like just a normal school in terms of [EMFs]." On March 16, the *News-Press* reported that the school board had decided to rope off sections of the school that have strong magnetic fields.

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Brodeur and Sagan would have faced each other again on *Nightline*—if the producers of the ABC-TV News late night show had had their way. An ABC spokeswoman told us that Sagan refused to appear because Brodeur was also scheduled to be interviewed. The *Nightline* show was to air on March 8, the day of the congressional hearing, but had to be delayed until the following night. Nightline host **Ted Koppel** interviewed Carnegie Mellon University's Dr. **Granger Morgan** and the New York Power Authority's **James Cunningham**, as well as Brodeur. A transcript is available for $3.00, prepaid, from: Journal Graphics, Inc., 267 Broadway, New York, NY 10007. Credit card orders: (212) 227-7323. Specify Program #2295.

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Dr. **Jerry Phillips**, whose previous work has demonstrated that 60 Hz EMFs alter growth and membrane properties of human cancer cells, is leaving San Antonio, TX. Formerly with the Cancer Therapy and Research Center, he is joining the research group at the VA Medical Center in Loma Linda, CA, headed by Dr. **Ross Adey**. He and his wife, Dr. **Wendy Haggren**, will be studying the effects of 60 Hz magnetic fields on gene transcription.

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The widely-read ***Harvard Medical School Health Letter*** took a flippant look at EMF risks in its March issue. The newsletter asked the question, "How real a hazard?" and answered that, "It's impossible to say...." Then it offered the following Rx: "In the meantime, the very cautious may wish to unpack grandma's quilt, turn off the television and curl up with a good novel or seed catalog—or better yet, go out and cultivate the garden." The Harvard analysis appears to have been based on two interviews—with Drs. **Tom Tenforde** and **David Carpenter**. Dr. **Edward Wolpow**, a member of the NY Power Lines Project scientific advisory group, is a member of the Harvard letter's advisory board.

Plans for NYPLP-II Continue

The New York State Department of Health (DOH) and the New York Public Service Commission (PSC) are moving forward towards setting up a new research effort on electromagnetic field (EMF) health effects. The PSC is seeking up to $10 million for the proposed second New York Power Lines Project (NYPLP-II), which would follow up on the findings and recommendations of the original panel report (see *MWN*, J/A87 and N/D88).

"It is important that we reach some definite conclusion on what the hazard is," DOH's Dr. David Carpenter told *Microwave News*. The state cannot conclude that there is a real likelihood of a health risk and then leave it hanging, he said. Carpenter headed the first NYPLP, which sponsored the Savitz epidemiological study as well as a number of other key studies.

Like the original project, NYPLP-II would be directed by an independent panel of experts who would select the research studies to be funded. It would run for five years and would most likely be supported by a consortium of state utilities.

The PSC's Dr. Dan Driscoll has been meeting with state utilities to discuss their funding NYPLP-II. "Everything is still in the planning stage," he said in an interview, adding that he hopes to have something definite "within the next few months." Driscoll noted that the New York Power Authority's March 8 proposal for a $15-20 million national EMF research program "will certainly have an influence on the next round of discussions" (see p.1).

Driscoll estimated the cost of the project at $3-10 million, depending on whether the PSC can convince other state commissions, as well as national groups, to participate in a joint EMF research effort—organizations in other countries are also being approached. The project would be limited to $3 million if support comes only from NY utilities, he said.

On December 19, the PSC hosted a workshop on ongoing and future EMF research and the adequacy of its response to the NYPLP panel's recommendations. Five of the original panel members attended. Driscoll said that many of the participants felt that it was "important to do more basic research," particularly on melatonin production, circadian rhythms, gene expression and calcium efflux—areas which have shown "robust effects." The participants also called for further investigation into effects on learning, reaction time and behavior, as well as on neurobiology.

NY Proposes 200 mG Limit

The New York Public Service Commission (PSC) has proposed an interim magnetic field limit of 200 mG for new transmission line right-of-ways (ROWs). The announcement came on March 28, as *Microwave News* went to press.

The limit is twice as lenient as the 100 mG recommendation made by a PSC task force in 1988. Dr. Dan Driscoll, who chairs the task force, told *Microwave News* that the 200 mG limit was determined on the basis of technical design considerations—not health concerns.

To obtain a copy of the proposed standard, contact: John J. Kelliher, Secretary, New York PSC, 3 Empire State Plaza, Albany, NY 12223, (518) 474-2500. For more on development of the standard, see *MWN*, M/A88 and M/J88.

Power Line Controversy Heats Up in the U.K.

Allegations that government officials are failing to protect the public and workers from power line and other types of electromagnetic fields (EMFs) are being raised in the U.K. The charges were made in the February issue of *Electronics World + Wireless World (EW+WW)*, a monthly trade magazine, which devoted extensive coverage to what it called the "Killing Fields."

In an editorial in its March issue, the magazine took the state-owned Central Electricity Generating Board (CEGB) to task for refusing to release the results of an epidemiological study. Dr. Robin Cox, chief medical officer for the CEGB, denied the allegations and said that the results will be submitted for publication, but *EW+WW* rejected his explanation and argued that Cox is hiding the information. "It seems logical to look for other motives," Editor Frank Ogden wrote.

Ogden suggested that, "Publication would...interfere with the forthcoming privatization [of CEGB] scheduled for the end of the year" (see *MWN*, M/A88). If CEGB's preliminary findings support a link between EMFs and cancer, Ogden noted, there will be public calls for compensation and mitigation.

The contributors to the "Killing Fields" special issue were: Alasdair Philips of Electronics and Computing for Peace; Simon Best, a coauthor of the 1989 book, *Electromagnetic Man;* and Roger Coghill, a private consultant who has claimed an association between sudden infant death syndrome (SIDS) and EMF exposure (see *MWN*, M/A89).

Philips questioned the safety of the National Radiological Protection Board's (NRPB) extremely low frequency (ELF) exposure guideline of 2 mT (20 G or 20,000 mG). He charged that, in its references, the NRPB had "deliberately excluded" most of the reports showing possible dangers from low-level, non-thermal EMFs. Indeed, the literature review promised in 1988 has still not been published.

The special report coincided with an editorial in the February 1990 issue of the *Journal of the Royal Society of Medicine* by CEGB's Cox, who concluded, on the basis of completed research, that "fields from power frequency systems do not have any significant health effects for the general public."

The editorial sharply criticized epidemiological studies of residential ELF exposures by Dr. Nancy Wertheimer and Ed Leeper and by Dr. David Savitz. "An objective assessment of the epidemiological evidence must...lead one to the conclusion that it is weak and unconvincing," Cox wrote. He argued that the public has been swayed by "quasi-scientific work."

Cox noted, however, that confirmation of Savitz's findings would suggest "a significant public health problem because of the ubiquity of the fields" at the 2 mG level found by Savitz to be associated with an increased risk of childhood cancer.

At the NRPB, Assistant Director J.A. Dennis has taken a more moderate position. In a letter that appeared in the April issue of *EW+WW*, Dennis stated that there is "a growing literature" associating EMF exposures and cancer. Responding to charges that the NRPB had discounted the epidemiological data without cause, Dennis cited inconsistencies in the data. "Given the uncertainty about the reality of the risk and the considerable uncertainties in its quantification, it would be premature to specify limits based on the possibilities for long-term effects on health," he wrote. "Nevertheless, there is obviously a case for avoiding unnecessary exposures and reducing exposure levels where this can be done easily." He also advocated further research.

The stirring within the U.K. electronics community is having an impact in the U.S. An editorial in the March 15 issue of *Electronics Design News* summarized *EW+WW*'s major findings and joined the call for more research. "Clearly, it's time to carefully examine our standards for exposure to electromagnetic radiation in the [ELF] portion of the spectrum," the editorial stated.

Censorship at the BBC

The British Broadcasting Corp. (BBC) was pressured into dropping an interview with the CEGB's Dr. Robin Cox, in which he refused to give assurances that there were no health risks associated with living next to power lines, according to a report by Tim Kelsey in the April 1 issue of *The Independent on Sunday*, published in London.

Cox was interviewed for a segment aired on the March 22 edition of the BBC television show, *Nature*. At the last minute, a second interview with Cox was substituted over the objections of the BBC producers.

The National Grid Co., which owns and operates the power lines in the U.K., asked the BBC to delete the first interview, because, as a spokesman for the National Grid told the *Independent*, Cox "had been ambushed" and the company was seeking to protect Cox's reputation—not to save the industry from embarrassment.

New from EPRI

The following publications from the Electric Power Research Institute (EPRI) range in subject matter from power line (AC and DC) bioeffects to electromagnetic interference (EMI). Copies (except for the *EPRI Journal* and the Delavan proceedings) are available, prepaid, from: Research Reports Center, PO Box 50490, Palo Alto, CA 94303, (415) 965-4081.

• "Pursuing the Science of EMF," ***EPRI Journal***, January/February 1990. In a cover story on EMFs, EPRI reviews its growing research efforts, with an emphasis on laboratory, exposure assessment and epidemiological studies. The 14-page article includes a special section on the Matanoski telephone linemen studies (see *MWN*, N/D89 and p.2) For more information, contact: Editor-in-Chief, *EPRI Journal*, PO Box 10412, Palo Alto, CA 94303.

• ***Extremely Low Frequency Electric and Magnetic Fields and Cancer: A Literature Review***, EN-6674, $32.50, December 1989. This report is a revision of a background paper prepared for EPRI's July 1988 workshop on EMFs and cancer research held in Carmel, CA. It is supplemented by abstracts of the papers presented at the workshop. Among the topics covered are epidemiological and laboratory studies, as well as dosimetric and engineering factors. The review was prepared by Drs. Robert Goldberg and William Creasey of Information Ventures, Inc. in Philadelphia, PA, the firm that used to publish the BENER reports. An electronic version of this data base will be available soon.

• ***Pilot Study of Residential Power Frequency Magnetic Fields***, EL-6509, Final Report, $40.00, September 1989. Luciano Zaffanella of General Electric found that the largest contributors to residential magnetic fields are transmission and distribution lines, grounding system currents and unusual wiring configurations. He concluded that magnetic fields from distribution line net currents and residential grounding system currents "could not be predicted solely by visual inspection of distribution line characteristics" and that "despite a correlation between [Wertheimer-Leeper] wiring code and magnetic field, the code would misclassify a large portion of residences...." These observations were based on measurements at 53 residences. EPRI is expanding the study to include 1,000 homes around the country.

• ***Identification of Ions Near HVDC Transmission Lines***, EN-6391, Final Report, $25.00, May 1989. F.L. Eisele of the Georgia Institute of Technology in Atlanta offers evidence that the types of ions generated near high-voltage DC (HVDC) transmission lines are chemically similar to those found in the natural environment. His results suggest that the

lifetimes of both positive and negative ions are important determinants of the ion spectra found near HVDC lines.

• ***Current Studies of Possible Health Effects of Exposure to Power Frequency Electric and Magnetic Fields***, EN.3009.11.89R, $200.00 (free to members), November 1989. This 30-piece slide show on EMFs, which includes a script for speakers, describes EPRI's current research program. Also available free of charge ($20.00 for each additional copy) are two related publications, ***Electric and Magnetic Fields: Human Health Studies***, EN.3010.11.89, November 1989; and ***Electric and Magnetic Field Fundamentals***, EN.3012.9.89, September 1989.

• ***Mutual Design: Overhead Transmission Lines and Railroad Facilities; Susceptibility Program***, EL-6462-M, Final Report, $32.50, July 1989. This is the latest report on possible EMI from power lines to railroad signaling systems (see also *MWN*, S83 and Mr84). A team led by M.J. Frazier of the Science Applications International Corp. in Hoffman Estates, IL, developed a method of quantifying the EMI threat with a laboratory track simulator. The lab test "agreed very closely with field results, verifying the accuracy of the simulator." The Association of American Railroads cosponsored the study with EPRI.

• ***EMDEX System Manuals, Volume 1: User's Manual*** and ***Volume 2: Technical Reference Manual***, EN-6518, Interim Reports, $25.00 and $32.50, respectively, October 1989. Volume 1 provides instructions for using the EMDEX measurement system, an ELF dosimeter; Volume 2 presents detailed descriptions of the hardware and software. The reports were prepared by Enertech Consultants in Campbell, CA.

• ***Proceedings of the EPRI Utility Seminar on Power Frequency Electric and Magnetic Field: Laboratory Research***, held September 27-29, 1989, in Delavan, WI. Among the topics addressed were cancer and cell physiology—as well as health risk research in general. Copies are available for $50.00 (EPRI members, public agencies, nonprofits and universities) or $250.00 (all others) from: Robert S. Banks Associates, Inc., 825 Washington Ave., SE, Suite 104, Minneapolis, MN 55414, (612) 623-4646. Note: Only a limited number of copies are available.

HIGHLIGHTS

RF/MW Stimulates & Suppresses Human Brain Tumor Cells

Five days after a two-hour exposure to radiofrequency and microwave (RF/MW) radiation, human brain tumor cells continued to proliferate at an abnormally high rate. At higher levels, however, the radiation suppressed cell growth. Drs. Stephen Cleary, Li-Ming Liu and Randall Merchant of Virginia Commonwealth University in Richmond observed similar results one and three days following exposure.

The researchers found highly statistically significant enhancement at specific absorption rates (SARs) of 5 or 25 W/Kg. At higher SARs, cell growth was suppressed. Essentially the same effects were obtained for exposures to unmodulated 27 MHz and 2450 MHz radiation.

In a paper published in the January 1990 issue of *Radiation Research (121*, pp.38-45), Cleary and coworkers report that RF/MW radiation had pronounced effects on the DNA and RNA synthesis of glioma cells, as measured by the incorporation of thymidine and uridine—genetic building blocks.

The cells were kept at a constant temperature during exposure, allowing the authors to conclude that the "effects were not induced indirectly by heating."

In a second paper, scheduled to appear later this year in *Bioelectromagnetics*, the team will report parallel effects when lymphocytes—white blood cells—were exposed under the same conditions. These cells were untransformed.

These results have important implications: on the one hand, RF/MW radiation may promote cancer and, on the other hand, the radiation could be harnessed to treat malignancies. "If you stimulate transformed cells, you can enhance their potential growth," Cleary told *Microwave News*. "But on the upside, if you can retard them, there is a potential for great benefit." For example, Cleary envisions the day when blood cells may be circulated out of the body, as in dialysis, and exposed to RF/MW radiation to suppress proliferation of cancer cells.

In the paper, the researchers say that their findings are "significant since [they] suggest the possibility of cumulative effects of RF radiation when exposure occurs at intervals on the order of five days or less." The combined findings suggest a "general cellular response" to RF/MW radiation. The team hypothesizes that the effects may be explained by a shifting of cell cycles.

The results pose many questions. For instance: Are there effects at SARs below 5 W/Kg? Does the stimulation continue beyond five days after exposure? What are the effects of multiple, intermittent exposures? Would different effects be observed *in vivo* where heat would not be dissipated as effectively as *in vitro*?

Cleary is having difficulty securing funds for further research. "It's very frustrating," he said. "Without a new grant, we will be unable to investigate the effects of cumulative and multiple exposures or to determine mechanisms."

New World Health Organization Report on NIER

The World Health Organization's (WHO) Regional Office for Europe has published a second edition of its report on *Non-Ionizing Radiation Protection*. The 346-page volume covers the spectrum from extremely low frequency (ELF) fields to ultraviolet radiation, and includes a section on regulation and enforcement.

Since the first report was issued in 1982 (see *MWN*, My83), "...much new research has been performed and experience gained in NIER protection, especially in the areas of radiofrequency [RF] radiation and electric and magnetic fields [EMFs]," according to the WHO.

In the chapter on RF radiation effects, Drs. P.A. Czerski, Joe Elder, Kjell Hansson Mild, Asher Sheppard and Maria Stuchly conclude that limiting occupational and general population exposures by "voluntary or mandatory standards is desirable," and note that the IRPA RF exposure guidelines reflect the "emerging international consensus." They recommend that future research look at frequencies below 10 MHz, "where few data exist."

Drs. Larry Anderson and William Kaune, who prepared the chapter on ELF fields, conclude that current research suggests that EMFs are "environmental agents of relatively low potential hazard to biological systems," and that, "Human data from epidemiological studies, including reported effects on cancer promotion, congenital malformations, reproductive performance and general health, though somewhat suggestive of adverse health effects, are not conclusive."

Non-Ionizing Radiation Protection, Second Edition, (WHO Regional Publications, European Series No.25, 1989; Order No.1310025), edited by Michael Suess and Deirdre Benwell-Morison, is available for $34.40 from: WHO Publications Center USA, 49 Sheridan Ave., Albany, NY 12210; or for 43 Sw. Fr. from: WHO Distribution and Sales, 1211 Geneva 27, Switzerland.

Electronic Devices-Avionics EMI Report Available

The Radio Technical Commission for Aeronautics (RTCA) has released its report on electromagnetic interference (EMI) to aircraft communications and navigation systems from portable electronic devices. The RTCA recommends that the use of all such devices be prohibited during takeoffs and landings.

Overall, the RTCA concludes that the risk of interference is "small" but recommends that the Federal Aviation Administration develop rules which "specify the conditions under which portable electronic devices may be operated on an aircraft." The RTCA also recommends that the Federal Communications Commission create a new class of carry-on devices and set frequency and amplitude limits for their radiation emissions.

The RTCA report was essentially completed in late 1988 and its findings were made available to *Microwave News* at that time (see *MWN*, N/D88).

The two-volume report, *Potential Interference to Aircraft Electronic Equipment From Devices Carried Aboard* (RTCA/DO-199), was prepared by Special Committee 156, chaired by Frank White. Volume I contains the findings and recommendations, as well as data collection and analysis. Volume II includes supporting reference materials. Both are available from: RTCA, One McPherson Square, 1425 K St., NW, Suite 500, Washington, DC 20005, (202) 682-0266. The cost is $32.00 per volume in the U.S., Canada and Mexico ($40.00 elsewhere), plus $4.00 shipping and handling ($8.00 elsewhere). Prepayment is required.

New Microwave Meters from Narda and Holaday

The two leading microwave (MW) meter manufacturers have introduced new monitoring devices.

Constant Surveillance Monitor

Loral Microwave-Narda is marketing a meter called SMARTS that sounds an alarm and flashes lights whenever field levels exceed 1 mW/cm^2. The device is the first of its kind, making it possible to warn of possible overexposure at all times. Previously, high field levels could be detected only while measurements were being taken with a hand-held meter. The monitor operates at 2 to 18 GHz.

The model 8820 SMARTS (Surface Mounted Automatic Radiation Threshold Sensor) is similar in concept to a household smoke detector and is designed for sites where exposure is a constant concern, such as areas next to high-power MW systems and satellite uplink stations.

The model 8820 SMARTS is available for $2,500.00 in the U.S. from: Loral Microwave-Narda, 435 Moreland Rd., Hauppauge, NY 11788, (516) 231-1700.

Low-Cost Oven Meter

Holaday Industries is selling a new inexpensive microwave oven meter. The model HI-1801 is calibrated from 0 to 10 mW/cm^2. A "check" function responds to very low leakage levels to assure that the meter is working.

Model HI-1801 is available at the introductory price of $289.00 (for a limited time) from: Holaday Industries, Inc., 14825 Martin Dr., Eden Prairie, MN 55344, (612) 934-4920.

(D-NJ), who announced that he will introduce legislation to increase federal research and public information.

Almost all of the hearing witnesses backed a significantly larger federal power line research program; the only opposition came from the Department of Energy (DOE) and the Environmental Protection Agency (EPA)—ironically, the two agencies historically most involved in EMF research.

Kostmayer appeared visibly frustrated by DOE and EPA officials. Both agencies "are resistant to recognizing the potential seriousness of the problem we're facing," he said in an interview with *Microwave News*. DOE is "indifferent, almost cavalier," he added.

Robert San Martin, a deputy assistant secretary of energy, described the department's EMF research as "rational and reasonably satisfactory at this time."

EPA's Richard Guimond, head of the Office of Radiation Programs, testified that, "We don't advocate modifying our role at this time." Guimond said that EPA currently is completing a cancer assessment on EMFs and is preparing a handbook on EMFs similar to EPA's widely distributed radon handbook.

The hearing attracted an overflow audience but only one subcommittee member other than Kostmayer.

Industry Initiative

James Cunningham, a senior vice president at the New York Power Authority (NYPA) who appeared on behalf of the Large Public Power Council (LPPC), proposed that the electric utility industry voluntarily provide $15-20 million for a federally supervised research program. The proposal seemed to surprise other industry officials, who opposed it.

Dr. Leonard Sagan of the Electric Power Research Institute (EPRI) called instead for more federal funding. "The federal government has failed in its responsibility," Sagan charged. It should "engage in a far greater research program than formerly." In contrast to most other witnesses, Sagan characterized EMF risks as "entirely hypothetical and uncertain." He cautioned, however, that confirmation of health effects would involve "potentially great costs to the nation."

Kostmayer told *Microwave News* that he would consider introducing legislation to provide tax credits or other incentives to encourage utilities to contribute. If LPPC's proposal is not viable, he will support legislation to increase federal funding. "If we can get the industry to pay, that's great," he said. "If not, we're going to have to find the federal funds."

Dr. Granger Morgan, of Carnegie Mellon University and a coauthor of the 1989 Office of Technology Assessment (OTA) report recommending "prudent avoidance" (see *MWN*, J/A89), also identified a "strong need for a stronger and more consistent federal role." Morgan warned that, "If there are health consequences, there will not be time to learn how to respond." Morgan specifically cautioned that the power line issue may be "driven" by liability. "Spending the next 10-15 years litigating is not in anybody's best interest," he said.

Prudent Avoidance?

Prudent avoidance means different things to different people. Rep. Peter Kostmayer asked several witnesses whether they have changed their lifestyles out of concern about EMF exposures. Here's what they said:

Carnegie-Mellon's Dr. Granger Morgan reported that he had moved his son's bed across the room away from the household electricity point of entry, gotten rid of his electric blankets and moved clocks away from beds. Chris Dodge of the Library of Congress took less extensive measures, putting away his electric blanket "except during the last cold snap." OTA's Karen Larsen has not yet been sufficiently concerned. "One of these days I'll get measurements," she reported.

In response to the perennial question, "Given the option between buying a house along a transmission line right-of-way (ROW) and buying an identical house at the same price at another location further from the ROW, which would you buy?" Morgan said he would choose to live further from the line. He first protested that there are numerous risk factors that might influence his decision but then conceded that, "If it's a cost-free choice, obviously I'd live in the house that doesn't have an external source."

Diane Allen, the TV reporter, said that she had her utility bury the main entry line to her house. Philadelphia Electric (PE) had found "very high" magnetic field levels at the point of entry, she said. Subsequent readings found fields just 10% of what they had been. In addition, Allen threw away her electric blanket and moved the clock radios from her children's bedstands.

PE's Charles Boeggeman was the only utility official asked about residential EMF levels. He said that his company has responded to more than 100 requests for measurements over the past three years. There is no set protocol and the readings are "not exhaustive," he explained. Boeggeman said that if a field of 30 mG is found in a location, for example, "we may tell the resident to consider moving the baby's crib."

In testimony submitted after the hearing, the Electromagnetic Energy Policy Alliance, a trade association, called prudent avoidance "illogical and inappropriate" and opposed it altogether.

DOE, EPA Programs Critiqued

Dr. David Carpenter, who supervised the NYPLP, sharply criticized federal efforts in general and DOE's program in particular, calling it a "disaster." "The fault lies with the federal government, that they have not taken the lead," Carpenter testified. There is a need for more money and better management, he added.