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October 15, 2001

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Magalie Roman Salas
Secretary
Federal Communications Commission
Washington, D.C. 20554

Re: Petition for Inquiry of the EMR Network

Dear Madame Secretary:

As promised in my e-mail earlier today, here are seven copies of the document filed, and stamped as received, September 25, 2001. To my recollection, an original plus four plus four (for Commissioners) were submitted, along with a separate courtesy copy for Bob Cleveland of OET.

Bob has his copy. The multiple copies provided today are for the Commissioners and whatever additional uses you may have. I would appreciate your recording this submission as having occurred on September 25, 2001.

In an earlier conversation, you indicated that one of your colleagues had proposed treating the Petition as one for rulemaking. We deliberately petitioned for the kind of Inquiry that sometimes precedes rulemakings, as a means of gathering information from the public about the content and shape of new rules. In the end, however, the captioning of the proceeding is up to the Commission.

Please let me know if you have questions or need additional information.

Sincerely,

James R. Hobson
Counsel for EMR Network

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In the Matter of	)
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Environmental Effects of Radiofrequency	)
Radiation: Petition for Inquiry to Consider	)
Amendment of Rules in Parts 1 and 2	)

PETITION FOR INQUIRY

OF THE

EMR NETWORK

James R. Hobson
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September 25, 2001

ITS ATTORNEY

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SUMMARY

In June 1999, members of the Radiofrequency Interagency Work Group, including the FCC's Senior Scientist, Dr. Robert Cleveland, wrote to a subcommittee of the Institute of Electrical and Electronic Engineers, discussing 14 issues "that we believe need to be addressed to provide a strong and credible rationale to support RF [radiofrequency] exposure guidelines." That letter is the blueprint for the Inquiry the EMR Network asks the Commission to open.

It has been 10 years since the Institute's promulgation of the RF protection standard on which current FCC rules are based. Significant research in the field has been conducted, peer-reviewed and published since then. Even though the pertinent regulations were last revised in 1996-97, the supporting scientific and medical studies are no more recent than 1985. It is past time to take account of substantial later work.

The current RF protection standards are based on short-term exposures demonstrated to cause harmful overheating of human body tissues. The principal question asked by Dr. Cleveland and his fellow Work Group members is how to approach "chronic exposure to RF radiation . . . that does not elevate tissue temperature on a macroscopic scale."

While a recent report from the General Accounting Office does not purport to answer that question, it implicitly faulted the level of publicly-funded research into human health effects of mobile phone use and identified differences in the way the FCC and another federal agency treat "uncertainty factors" in safety risks. Such factors and numerous other topics are reviewed in the Work Group letter and deserve the thorough exploration of an Inquiry potentially leading to revised and improved RF radiation protection rules.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)
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Environmental Effects of Radiofrequency	)
Radiation: Petition for Inquiry to Consider	)
Amendment of Rules in Parts 1 and 2	)

PETITION FOR INQUIRY

The EMR Network[1] respectfully requests that the Commission issue a Notice of Inquiry designed to gather information and opinion about the need to revise the regulations in Parts 1 and 2 of the FCC's Rules concerning the environmental effects of radiofrequency radiation ("RFR"). The Inquiry would focus on Sections 1.1307(b), 1.1310, 2.1091 and 1.1093 and the associated procedures for Environmental Assessment ("EA") and Environmental Impact Statements ("EIS").

Introduction. On June 17, 1999, members of the Radiofrequency Interagency Work Group ("IWG"), including the FCC's Senior Scientist, Robert Cleveland, wrote to Richard Tell, a consulting radio engineer who chairs the Institute of Electrical and Electronic Engineers ("IEEE") SCC28 Subcommittee 4 Risk Assessment Working Group ("SC 4").[2] Their letter (attached as Exhibit A) identified and briefly discussed 14 issues "that we believe need to be addressed to provide a strong and credible rationale to support RF exposure guidelines."

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[1] The EMR Network is a non-profit corporation, based in Marshfield, Vermont, of "citizens and professionals for the responsible use of electromagnetic radiation." More information can be found at www.EMRNetwork.org.

[2] The IEEE, in collaboration with the American National Standards Institute ("ANSI"), since 1982 has been a principal source of expert advice to the FCC about safeguarding employees and the general population from the hazards of RFR exposure. *Amendment of Part 1*, 100 FCC 2d 543, 544 (1985). *See also*, Note to Introductory Paragraph, 47 C.F.R.§1.1310.

Less than two years earlier, the FCC had essentially affirmed, on reconsideration, the RFR protection rules now found in Parts 1 and 2. The agency acknowledged that the revised regulations continued to be based on "acute" (short-term) and "thermal" (tissue-heating) effects of RFR. Claims of "chronic" (long-term) effects below the exposure levels known to cause heating of human tissue were met with this disclaimer:

> It would be impracticable for us to independently evaluate the significance of studies purporting to show biological effects, determine if such effects constitute a safety hazard, and then adopt stricter standards than those advocated by federal health and safety agencies. This is especially true for such controversial issues as non-thermal effects and whether certain individuals might be "hypersensitive" or "electrosensitive."[3]

In its August 1999 revision of OET Bulletin 56, a compilation of questions and answers on potential RFR hazards, the Commission described reports of biological harm from low-intensity, non-thermal effects as "ambiguous and unproven." Admitting that the phenomena may exist, "whether or not such effects might indicate a human health hazard is not presently known." (OET Bulletin 56, 8)

Against this backdrop of skepticism, the comments of the Interagency Working Group compel a new look at the issues for the first time in a decade since the ANSI-IEEE standards were adopted. On the question of "adverse effect level," the agency scientists write:

> Since the adverse effect level for the 1991 guidelines was based on acute exposures, does the same approach apply for effects caused by chronic exposure to RF radiation, including exposures having a range of carrier frequencies, modulation characteristics, peak intensities, exposure duration, etc., that does not elevate tissue temperature on a macroscopic scale?

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[3] Guidelines for Evaluating the Environment Effects of Radiofrequency Radiation, 12 FCC Rcd 13494 (1997), ¶31.

Concerning the Specific Absorption Rate ("SAR") – relative absorption of electromagnetic energy per second (watts) per unit of body mass (kilograms) –the IWG suggests:

> [A]n effort should be made to base local SAR limits on the differential sensitivity of tissues to electric fields and temperature increases. For example, it seems intuitive that the local limits for brain and bone marrow should be lower than those for muscle, fat and fascia; this is not the case with the current limits which implicitly assume that all tissues are equally sensitive (except for eye and testicle).

Finally, as to acute versus chronic exposures, "the past approach of basing the exposure limits on acute effects data with an extrapolation to unlimited chronic exposure durations is problematic."

> For lower level ("non-thermal") chronic exposures, the effects of concern may be very different from those for acute exposure (e.g., epigenetic effects, tumor development, neurologic symptoms). . . .[A] clear rationale needs to be developed to support the exposure guideline for chronic as well as acute exposure.

As will be developed below, taken together the 14 issues identified by the IWG are the blueprint for the Notice of Inquiry we request. We see the FCC's effort not as duplicating but complementing and expanding the on-going work of IEEE and other RFR standards bodies. The IWG describes its letter as a "response to previous requests for greater participation on our part in the SCC28 deliberations on RF guidelines." In turn, we would expect SC 4 participation in the Notice of Inquiry.

Nor should the Notice of Inquiry be seen as the FCC's responsibility alone. The other agencies on the IWG – EPA, FDA, OSHA, NIOSH and NTIA – are part of the body of expertise on which revised RFR rules must be founded. As the FCC has acknowledged:

> In the past, the Commission has stressed repeatedly that it is not a health and safety agency and would give great weight to the judgment of these expert agencies with respect to determining appropriate levels of safe exposure to RF electromagnetic fields.

12 FCC Rcd at ¶30. The statement is as true today as it was four years ago. The participation of the expert agencies in the Notice of Inquiry, and in any subsequent rulemaking, not just behind the scenes as an IWG but also publicly and openly, will be important to the credibility and acceptance of the outcome.

Background. As noted above, the current version of the FCC's Bulletin 56 describes claims of harm from low-exposure, non-thermal RFR effects as ambiguous and unproven. Under this line of reasoning, to establish biological effects from RFR would be insufficient. The effects must be shown hazardous to human health. Recently, however, Dr. Christopher Forrest of the Johns Hopkins University Medical School was quoted on the subject of "proof" linking smoking to lung cancer:

> The initial evidence, he said, was observational. Scientists found a "dose-response relationship" between smoking and disease: the more a person smoked, the greater the likelihood of sickness. They found a temporal relationship: smoking preceded cancer. But still, the tobacco industry could claim there was no proof. That did not change, Dr. Forrest said, until molecular biologists showed smoking caused genetic changes in the lung.[4]

What we now know about smoking and disease gives rise to this fair question: Before the evidence became conclusive, did government do all it could or should have done to reduce health risks – from warnings on cigarette packs to outlawing sales to minors to bans on indoor smoking in spaces accessible to the public?

When the present RFR protection rules were adopted in 1996-97, the FCC and its sister agencies, and the standards bodies on which they relied, put most of their trust in a two-step

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[4] Sheryl Gay Stolberg, "Science, Studies and Motherhood," *New York Times*, April 22, 2001, "Week in Review," 3.

process of (1) identifying "studies purporting to show biological effects" and (2) determining "if such effects constitute a safety hazard." (text at note 3, *supra*) Thus, not even the special concerns of one of the standards bodies for "modulation effects" could move the agency to greater precaution:

> Since we have no specific indication of exposure hazards related to modulation caused by FCC-regulated transmitters, and since at this time no new proof of such hazards has been presented by petitioners, we continue to believe it would be premature to adopt the NCRP modulation criteria.

12 FCC Rcd at ¶33.

Increasingly, scientists working in the field of non-ionizing RFR are recommending that we treat biological effects from low-intensity exposures with more respect until we better understand their mechanisms. This has long been the approach to ionizing (nuclear) radiation where, as discussed further below, considerable uncertainty persists over the magnitude of risk at low doses and low dose rates.[5]

In an Appendix to the Minutes of Evidence of the British Parliament's Select Committee on Science and Technology, September, 1999, physicist Dr. G.J. Hyland wrote:

> Although the existing safety guidelines are clearly necessary, they are quite inadequate. For they completely fail to consider the possibility of adverse health effects linked to the fact that living organisms – and only living ones – have the ability to respond to aspects of technologically produced radiation other than its intensity, and, accordingly, can respond at intensities well below the limits imposed by the safety guidelines. A

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[5] Human exposure to ionizing radiation is regulated to be "as low as reasonably achievable." Correlative language is found in the European Communities' Treaty of Maastricht (1992) which denominates a "precautionary principle" requiring society to take "prudent action when there is sufficient scientific evidence (but not necessarily absolute proof) and inaction could lead to harm." "Prudent avoidance" of RFR risks has made its way into adjudication of disputes over [illegible] antenna placement. *New York SMSA Limited Partnership v. Town of Clarkstown*, 00 Civ. 3[illegible] (KM), USDC-SDNY, May 26, 2000, 14.

> well-known example of this is the ability of a stroboscope -- even at quite low intensities – to induce epileptic seizures.[6]

This same "possibility of adverse health effects" is what the IWG members seem to be referring to in their letter to the IEEE, particularly on the issues of "adverse effect level" and "uncertainty factors."

Certainly there is no shortage of scientifically-observed biological effects of RFR in the literature of the past six years. A set of abstracts totaling nearly 100 pages has been compiled by Dr. Henry C. Lai, Research Professor in the Department of Bioengineering at the University of Washington.[7] From this list, Dr. Lai has identified at least six studies of low-intensity effects "within the intensities of cell mast [tower] exposure." About such exposures for humans, Dr. Lai has stated:

> Furthermore, when considering the health effect of radiation from cell phone masts, one has to consider the effect of long term exposure. People who live close to masts are constantly being exposed to the radiation for months or years. Even though the intensity is low, it would matter if the effects of the radiation turn out to be cumulative . . . Small doses cumulate[d] over a long period of time will eventually lead to harmful effects.[8]

One historical window on long-term harm may be the low-intensity microwave bombardment of the U.S. Embassy in Moscow from 1953 to 1976. Initially, the so-called "Lilienfeld Study," produced for the State Department in 1978 and aired in Congress the next year, found that "elevated lymphocyte [white blood cell] counts and protozoan intestinal diseases were the only

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[6] www.publications.parliament.uk/pa/cm199899/cmselect/cmsctech/489/489a23.htm

[7] www.EMRNetwork.org/research/research.htm#laisummary.pdf

[8] Letter to Committee on Natural Resources, Vermont House of Representatives, Exhibit B hereto.

statistically significant illness that occurred in Moscow Embassy personnel (versus controls)."[9] Later reviews of the Lilienfeld Study evidence, however, concluded that other statistically significant health effects had not been accounted for, including skin rashes and other problems; diseases of the peripheral nerves and ganglia; problems during pregnancy and childbirth; benign (male) and malignant (female) tumors. Additional effects that today we would associate with health were irritability, depression, loss of appetite and "concentration difficulties." *Id.* Noting that the Moscow radiation was phase-, amplitude- and pulse-modulated, and that its intensity range of 2 to 28 microwatts per square centimeter was hundreds of times lower than current U.S. exposure standards, Liakouris concludes:

> The evidence from the literature review, as well as from the Lilienfeld Study, support the RF sickness syndrome as a medical entity. The evidence also calls for new research in which current biomedical engineering knowledge of biosignal processing and instrumentation are used. *Id.*

These were not the views of the FCC, or of the standards bodies on which the Commission chiefly relied, at the time the current RFR safeguards were adopted. Both IEEE in its 1991 standard and National Council on Radiation Protection ("NCRP") in its 1986 recommendations settled on the same four watts per kilogram as a threshold for thermal effects harmful to humans. IEEE stated flatly there was no evidence that RFR at non-thermal intensities produced effects "meaningfully related to human health."[10] While NCRP had recommended stricter limits for workers exposed to certain modulations of RFR, and the FCC had called for

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[9] Liakouris, A.G.J., "Radiofrequency (RF) Sickness in the Lilienfeld Study: An Effect of Modulated Microwaves?", Archives of Environmental Health, Vol. 53, No. 3 (May-June, 1998), 237.

[10] Order on Reconsideration, 12 FCC Rcd 13494, ¶28.

specific comment on the point,[11] the Commission ultimately concluded that "there is insufficient evidence to give special consideration to modulation effects."[12]

This judgment could not take into account, however, scientific papers published even in the late 1980s, much less the decade of the 1990s. The cut-off for documentation in the NCRP 1986 recommendations was 1982 and for the IEEE standard of 1991, the review encompassed papers published in 1985 or earlier. Dr. Lai's compilation (note 7, *supra*), as well as footnotes to the Liakouris article (note 9, *supra*), suggest that research into human biological effects at sub-thermal intensities, with particular attention to modulated and pulsed radiation, has not been lacking. Regrettably, very little if any of this work has been done by, or under the sponsorship of, the expert federal agencies such as EPA, FDA and NIOSH.

For EPA, the past decade has been especially lean in resources for work on RFR. Under the federal government's Reorganization Plan No. 3 of 1970, in the wake of the National Environmental Policy Act ("NEPA") a year earlier,[13] EPA was assigned primary responsibility for guiding other federal agencies in the matter of both nuclear ("ionizing") and radiofrequency ("non-ionizing") radiation. For a time in 1995, it appeared that EPA would issue guidelines for RFR protection that could be adopted by the FCC in the rulemaking opened in 1993. The guidelines were never issued. Part of the explanation may lie in the 1990-2000 EPA budget summary attached hereto as Exhibit C.

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[11] Notice of Proposed Rulemaking, 8 FCC Rcd 2849 (1993), ¶25.

[12] Order on Reconsideration, 12 FCC Rcd 13494, ¶33.

[13] 42 U.S.C.§4321, *et seq.*

In a recent report focused on human health effects of mobile phone use, the General Accounting Office ("GAO") found evidence of harm inconclusive but implicitly faulted the level of publicly-funded research:

> At present, only one agency, NIH [National Institutes of Health], is providing significant funding for research related directly to the health effects of mobile phone emissions.

As to EPA, the agency "used to have a substantial in-house program of research on radiofrequency energy, but it was largely eliminated in the 1980s for budgetary reasons." The GAO report also noted an Air Force study of low-intensity RFR as it might affect the blood-brain barrier, a subject of considerable interest to private medical researchers as well.[14] One of the NIH projects, nominated by FDA, falls under the National Toxicology Program ("NTP") based at the National Institute of Environmental Health Sciences and anticipates spending as much as $10 million over several years in testing effects on rats from exposure to cellular phone frequencies and intensities.[15]

The relatively extended timeline for the NTP research need not, in EMR Network's view, delay the prompt opening of the requested Notice of Inquiry. Ample scientific work has been performed, peer-reviewed and published over the past 15 years to justify beginning now the painstaking and necessarily collaborative task of considering whether the FCC's RFR safeguards

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[14] "Research and Regulatory Efforts on Mobile Phone Health Issues," GAO-01-545, May 2001, 14. *See also*, Lai, note 7, citing Persson *et al.*, at 67. The blood-brain barrier is a selectively permeable membrane allowing useful fluids to pass from blood to brain while excluding toxins. Numerous studies cited in the Lai compilation found a "leakage" effect in mice irradiated with RFR.

[15] *Id.* The use of rats and other quick-breeding mammals facilitates the study of potential genetic effects from RFR exposure. FDA is primarily responsible, among federal agencies, to control radiation from electromagnetic or electronic equipment as it might affect human health and safety, while the FCC has plenary authority over the radio interference potentials in such emissions. The two agencies have collaborated in seeking to minimize inadvertent interference to pacemakers and medical monitoring devices. *See, e.g.*, Joint Statement, March 25, 1998.

should be revised. At the core of the effort should be a comprehensive examination of the 14 issues briefed in the IWG's June 1999 letter to IEEE. Each is discussed at greater length below.

I. Selection of an adverse effect level[16]

The IWG properly places on the table the question "Should the thermal basis for exposure limits be reconsidered." The IWG poses three sets of "selection criteria that could be considered in determining unacceptable/adverse effects." We believe that two of the three already have been demonstrated by research covered in the cited reviews. In terms of "minimal physiological consequences," such human effects as tinnitus (or ringing in the ears) have been shown beyond reasonable doubt and without much lingering controversy.[17] The Liakouris reexamination of the irradiation of the U.S. Embassy in Moscow (note 9, *supra*) suggests statistically significant evidence of irritability, loss of appetite and loss of concentration. Lai (note 7) lists DNA breaks, behavioral changes, learning and memory, cognitive functions and sleep disorders among topics in his compilation of findings by RFR researchers.[18]

The IWG's second set of selection criteria is captioned "measurable physiological effects, but no known consequences." To the extent that the minimal consequences posited in the first set are reversible (and the more so if they disappear), they tend to merge with "no known

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[16] It is not the FCC's task, of course, to consider the potentially beneficial uses of low-intensity RFR. The agency's rules, for example, control the high-intensity radiation of diathermy equipment without seeking to promote heat therapies. Nevertheless, it seems possible that better understanding of the likelihood of harm from non-thermal RFR exposures might also advance the medical use of "good" microwaves.

[17] "Proposed Alternatives for Controlling Public Exposure to Radiofrequency Radiation," 51 FR LEXIS 27318, July 30, 1986, at 24.

[18] We do not mean to make light of these effects by discussing them as minimal. Lai's compilation (note 7, *supra*) describes "irreversible infertility" from microwave irradiation (Magras and Xenos, 52), while also reporting both DNA damage and repair at varying specific absorption rates (J.L. Phillips *et al.*, 68-69).

consequences." Some might argue, however, that the absence of known consequences is more unsettling than the case of effects that are merely temporary or transitory. We have reason to be concerned that what seems to be without consequence on the "macroscopic scale" of the whole body may be producing hidden results at the cellular or molecular level.

Heretofore, the demonstration of a human biological effect has been insufficient, in the FCC's view, to offset the public interest in the technological advancement of wireless services and devices. Effects with unknown or minimal consequences essentially have been ignored. The IWG's suggestion that such effects might be deemed unacceptable, and therefore eligible for safeguarding by rule, would represent a break from the past, but not far-fetched in light of the practice of other agencies.

Where ionizing nuclear radiation is concerned, the regulations of the Nuclear Regulatory Commission ("NRC"), the Department of Energy and the Department of Transportation adopt the principle that exposure should be kept "as low as reasonably achievable."[19] As the NRC explained in fashioning this prudential standard:

> The [NRC] recognizes that, when application of the dose limits is combined with the principle of keeping all radiation exposures "as low as reasonably achievable," the degree of protection could be significantly greater than relying upon the dose limits alone.[20]

The NRC said the predictability of harm from high doses and high dose rates of ionizing radiation lessened when doses went down:

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[19] *See, e.g.*, 10 C.F.R.§§20.1003, 20.1101 (2000); 10 C.F.R.§835.2 (2000); 49 C.F.R.§172.803 (1996).

[20] "Standards for Protection Against Radiation," 56 Fed. Reg. 23360, May 21, 1991, section I.A. Dose limits are analogous to the time-averaged Maximum Permissible Exposures ("MPEs") found in Section 1.1310 of the FCC Rules or the separate SAR parameters in Sections 2.1091 and 2.1093.

> However, whether these effects occur at very low doses and, if they occur, whether their occurrence is linearly proportional to dose are not firmly established. This creates considerable uncertainty in the magnitude of risk at low doses and low dose rates. *Id.*, at section I.B.[21]

Similarly, the human biological effects of low-intensity RFR with variable modulations are "not firmly established." Whether and how to reduce the risk that these effects might be harmful are two key issues for the NOI in the category of "adverse effect level."

Just as the NRC considered and adopted a prudential standard not based solely on proven harm, so the IWG has recommended to IEEE, and we recommend here, that the criteria for selection of an unacceptable or adverse effects level not be restricted to harm to "bodily functions/systems." The criteria should also take account of physiological effects which are measurable but whose consequences are "minimal" or "unknown" – in order to guard against the risk that our characterizations are the result of ignorance rather than literal harmlessness of the effects. As Henry Lai writes in a forthcoming set of conference papers:

> Biological effects do not automatically mean adverse health effects. Many biological effects are reversible. However, it is very clear that low-intensity RFR is not biologically inert. Much more needs to be learned before a presumption of safety can be made.[22]

II. Acute and chronic exposures

We agree with the IWG that the "past approach of basing the exposure limits on acute effects data with an extrapolation to unlimited chronic exposure durations is problematic." We

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[21] On the complexities of non-linearity, see also Hyland (note 6, *supra*), "The Physiological and Environmental Effects of Electromagnetic Radiation," a report to the European Parliament released March, 2001, at www.europarl.eu.int./stoa/publi/pdf/00-07-03_en.pdf.

[22] "Biological Effects of Radiofrequency Radiation from Wireless Transmission Towers," in B. Blake Levitt, ed., *Cell Towers: Wireless Convenience? or Environmental Hazard?* (Safe Goods/New Century Publishing, 2001).

believe that much of the research published since 1985 supports the existence of "epigenetic effects, tumor development, neurologic symptoms" and other results which, if not permanently harmful, are at least worrisome enough to be guarded against. Again, the previously-cited Lai compilation and the studies identified in the Liakouris paper strongly suggest that the absence of macroscopic effects from RFR below thermal intensities is not a proof of harmlessness. Conversely, in the presence of demonstrable biological effects from long-term, low-intensity RFR, but absent clear proof that the effects are permanently harmful, the IWG is correct that "a clear rationale needs to be developed to support the exposure guidelines for chronic as well as acute exposure."

III. Tiered guidelines

It is conceivable that the application of a clear rationale for chronic, low-level exposure will, of itself, solve the issues arising from the conceptual dichotomy of an RFR-educated or aware workforce versus an ignorant or unaware general population. More likely, we think, is the IWG's statement that "if it is determined that certain populations (due to their health status or age) are more susceptible to RF exposures, then a multi-tiered standard, applicable only to those specific populations, may be considered." One of the concerns driving debate over the proliferation of wireless Local Area Networks ("LANs"), linking classroom computers internally and externally, is the fear that children are disproportionately susceptible to any harmful effects of this type of low-intensity radiation.[23]

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[23] www.EMRNetwork.org/schools/schools.htm#curry_broward.pdf

IV. Biological basis for local SAR limit

It may be "intuitive that the local limits for brain and bone marrow should be lower than those for muscle, fat and fascia," as the IWG suggests, but such intuition was not followed by IEEE in 1991. To the contrary, the recommended SAR exposure limits for hands, feet, wrists and ankles (presumably more bone than muscle or fat) were elevated, without any biological explanation, by 250% over their levels in the 1982 IEEE recommended standards. Nor did the FCC explain its choice of IEEE over the NCRP 1986 recommendation, where the limit for exposure of extremities remained unchanged. We agree with the IWG that "an effort should be made to base local SAR limits on the differential sensitivity of tissues to electric fields and temperature increases."

V. Uncertainty factors

The GAO report (note 14, *supra*) provides a timely illustration of why it is important, as the IWG suggests, "to provide a clear rationale for the use of uncertainty factors." Noting that the FCC requires testing of mobile and portable phones for compliance with the SAR limits in Sections 2.1091 and 2.1093 of the Rules, the GAO quoted Commission staff acknowledgment that

> [T]he combined effect of measurement uncertainty and procedural variations could, in some instances, cause a phone's actual maximum SAR level to fall somewhere within a range of plus or minus 50 to 60 percent (at a confidence interval of 95 percent) of the test result.[24]

According to the GAO report, the FCC does not incorporate "measurement uncertainty associated with the test result" into its compliance review, whereas FDA – in its comparable monitoring of microwave ovens – requires manufacturers to "take all measurement errors and

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[24] GAO-01-545, at 23.

uncertainty into account." The two agencies apparently were unaware of their different approaches, but the FCC told GAO it would contact FDA to discuss the issue. (GAO-01-545, at 24)

VI. Pulsed or frequency-modulated RF radiation

The NCRP recommendations of 1986, and several of the federal expert agencies, in their 1993-94 comments on the proposal leading to the current RFR rules, urged additional caution in dealing with modulated and pulsed radiation. The IWG brief on the issue appears to recognize that the FCC's response[25] in 1996-97 no longer suffices today, particularly with the overwhelming digitization of personal wireless services such as cellular and PCS, not to mention school and office wireless Local Area Networks ("LANs").

From the research reports referenced above – and, we suspect, from the many more sources that are likely to be identified in any new inquiry – we believe the answer is almost certainly "yes" to the question posed by the IWG: "Are the results of research reporting biological effects caused by intensity-modulated, but not CW [continuous wave, unmodulated], exposure to RF radiation sufficient to influence the development of RF exposure guidelines?" One of the tasks of an inquiry and any subsequent proposed rules will be to determine the risks of harm in the reported effects and to adopt regulatory safeguards in keeping with those findings.

VII. Induced and contact currents; transient discharges

While EMR Network agrees with the IWG's concerns over IEEE's recent elevation of the induced current limits and the need for quantitative criteria or other safeguards aimed at limiting exposure to transient discharges, we believe the unfinished business is even larger. Both

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[25] "There is insufficient evidence to give special consideration to modulation effects at this time." Report and Order, 11 FCC Rcd at ¶32; 12 FCC Rcd at ¶33.

IEEE 91 and NCRP 86 contain recommended safeguards against "shock and burn" from induced and contact currents. Rejecting similar advice from OSHA, NIOSH and EPA, the FCC concluded that measurement tools and other means of monitoring compliance were lacking. This finding, however, was reached in the face of contrary information in the 1993-96 record of the proceeding, and a new inquiry should determine whether it remains valid.[26]

VIII. Exposure limits at microwave frequencies

Purely as a matter of thermal protection, we would agree with IWG that the rationale for relaxing continuous-exposure limits as low in frequency as 1500 MHz (1.5 GHz) should not continue to be based on likening these radiation effects to sunburn. At 1500 MHz, microwaves can be expected to penetrate into tissue from an inch to 1.5 inches and to behave much differently than "millimeter waves" at 30-100 GHz. For reasons already discussed, however, we believe consideration must be given to greater protection against possible harm from RFR at less than thermal intensities, with or without modulation. Acute microwave "burn" is only one possible harm among several.

IX. Compatibility of RFR guidelines

We agree that compatibility of national and international RFR guidelines is important not only in the sense of "harmonization," which could enhance commerce and reassure travelers, but also as a matter of education. By comparing U.S. standards with those of other countries, we instruct ourselves in a potentially useful way about the reasons for the differences.

Attached as Exhibit D is a tabulation of national exposure limits for RFR in the frequencies generally employed for cellular and PCS mobile radio. Each entry has its own history, but it may be instructive to explore more deeply the common choice of Russia and Italy

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[26] 11 FCC Rcd at ¶¶130-151.

for a standard 60 to 100 times more protective than the U.S. As noted by Liakouris, Russian policy has been influenced by early agreement on so-called microwave sickness as a medical entity. Italy's reasons may be partly captured by the slang term, translated as "electrosmog," applied to ambient electromagnetic fields. Here are the lead paragraphs from two recent Reuters international news service dispatches:

> ROME, April 13 – Italian state prosecutors sequestered two U.S. armed forces radio transmitters in Naples two weeks ago because of excessive radio radiation, a U.S. Navy spokesman said on Friday.
>
> ROME, April 21 – The Italian government on Saturday said it had earmarked 267.5 million lire ($124,500) of revenue from the sales of five third generation mobile phone (UMTS) licenses to help combat electromagnetic pollution.

X. Time averaging; replication/validation; health effects literature

The importance of these topics raised by the IWG is self-evident. As Hyland has observed (notes 6 and 21, *supra*), the contingencies of hormonal, metabolic and other variations in living beings make absolute replication difficult if not impossible:

> This, of course, has serious implications on the acceptability of the philosophy underlying the current formulation of safety guidelines . . . namely, that they can be based only on established reproducible effects. The intensity-based heating effect of microwave radiation, of course, conforms to this criteria [sic], since being independent of whether the irradiated organism is alive or dead, it can be predicted to occur with certainty. Necessarily excluded, however, are effects contingent on the "aliveness" of the human organism.[27]

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[27] Note 6, *supra*, at 4.

Given the paucity of public research on RFR health effects in this country of late, which makes us all the more dependent on private studies of varying quality (and possibly self-interested funding or sponsorship), the literature reviews must be comprehensive and painstaking.

Conclusion. For all the reasons discussed above, it is time to inquire, systematically and with interagency collaboration, into the need for revising the RFR protection rules at Sections 1.1301 *et seq.* and 2.1091-1093. The opening of such an inquiry need not and should not await the completion of IEEE's current revision process, nor the outcomes of any current or soon-to-be-opened programs of research. The inquiry and any subsequent rulemaking are likely to be of sufficient duration to pick up important developments and findings over the next several years.

Respectfully submitted,

EMR NETWORK

By _____

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September 25, 2001

ITS ATTORNEY

[illegible] JRH00283.DOC

DEPARTMENT OF HEALTH AND HUMAN SERVICES

EXHIBIT A
Public Health Service

National Institute for Occupational
Safety and Health
Robert A. Taft Laboratories
4676 Columbia Parkway
Cincinnati OH 45226-1998

June 17, 1999

Mr Richard Tell
Chair, IEEE SCC28 (SC4)
Risk Assessment Work Group
Richard Tell Associates, Inc
8309 Garnet Canyon Lane
Las Vegas, NV 89129-4897

Dear Mr Tell

The members of the Radiofrequency Interagency Work Group (RFIAWG) have identified certain issues that we believe need to be addressed to provide a strong and credible rationale to support RF exposure guidelines I am writing on behalf of the RFIAWG members to share these ideas with you and other members of the IEEE SCC28, Subcommittee 4 Risk Assessment Work Group Our input is in response to previous requests for greater participation on our part in the SCC28 deliberations on RF guidelines The issues, and related comments and questions relevant to the revision of the IEEE RF guidelines, are given in the enclosure No particular priority is ascribed to the order in which the issues are listed

The views expressed in this correspondence are those of the members of the Radiofrequency Interagency Work Group and do not represent the official policy or position of the respective agencies

The members of the RFIAWG appreciate your consideration of our comments and welcome further dialog on these issues Feel free to contact me or any member of the RFIAWG directly A list of the members of the RFIAWG is enclosed, with contact information for your use

Sincerely yours,

W. Gregory Lotz

W Gregory Lotz, Ph D
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Enclosures (2)

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RF Guideline Issues

Identified by members of the federal RF Interagency Work Group, June 1999

Issue Biological basis for local SAR limit

The C95.1 partial body (local) exposure limits are based on an assumed ratio of peak to whole body SAR, that is, they are dosimetrically, rather than biologically based. Instead of applying a dosimetric factor to the whole body SAR to obtain the local limits, an effort should be made to base local SAR limits on the differential sensitivity of tissues to electric fields and temperature increases. For example, it seems intuitive that the local limits for the brain and bone marrow should be lower than those for muscle, fat and fascia; this is not the case with the current limits which implicitly assume that all tissues are equally sensitive (except for eye and testicle). If no other data are available, differential tissue sensitivity to ionizing radiation should be considered.

If it is deemed necessary to incorporate dosimetric factors into the resulting tissue-specific SAR limits these should be based on up-to-date dosimetric methods such as finite-difference time-domain calculations utilizing MRI data and tissue-specific dielectric constants. For certain exposure conditions FDTD techniques and MRI data may allow better simulation of peak SAR values. Consideration should be given to the practical tissue volume for averaging SAR and whether this volume is relevant to potential effects on sensitive tissues and organs

Issue. Selection of an adverse effect level

Should the thermal basis for exposure limits be reconsidered, or can the basis for an unacceptable/adverse effect still be defined in the same manner used for the 1991 IEEE guidelines? Since the adverse effect level for the 1991 guidelines was based on acute exposures, does the same approach apply for effects caused by chronic exposure to RF radiation, including exposures having a range of carrier frequencies, modulation characteristics, peak intensities, exposure duration, etc., that does not elevate tissue temperature on a macroscopic scale?

Selection criteria that could be considered in determining unacceptable/adverse effects include:

a) adverse effects on bodily functions/systems
b) minimal physiological consequences
c) measurable physiological effects, but no known consequences

If the adverse effect level is based on thermal effects in laboratory animals, the literature on human studies (relating dose rate to temperature elevation and temperature elevation to a physiological effect) should be used to determine if the human data could reduce uncertainties in determination of a safety factor

Issue Acute and chronic exposures

There is a need to discuss and differentiate the criteria for guidelines for acute and chronic exposure conditions The past approach of basing the exposure limits on acute effects data with an extrapolation to unlimited chronic exposure durations is problematic There is an extensive data base on acute effects with animal data, human data (e g MRI information), and modeling to address thermal insult and associated adverse effects for acute exposure (e.g., less than one day). For lower level ("non-thermal"), chronic exposures, the effects of concern may be very different from those for acute exposure (e g., epigenetic effects, tumor development, neurologic symptoms) It is possible that the IEEE RF radiation guidelines development process may conclude that the data for these chronic effects exist but are inconsistent, and therefore not useable for guideline development. If the chronic exposure data are not helpful in determining a recommended exposure level, then a separate rationale for extrapolating the results of acute exposure data may be needed In either case (chronic effects data that are useful or not useful), a clear rationale needs to be developed to support the exposure guideline for chronic as well as acute exposure

Issue One tier vs two tier guidelines.

A one tier guideline must incorporate all exposure conditions and subject possibilities (e g , acute or chronic exposure, healthy workers, chronically ill members of the general public, etc.). A two tier guideline, as now exists, has the potential to provide higher limits for a specific, defined population (e g , healthy workers), and exposure conditions subject to controls, while providing a second limit that addresses greater uncertainties in the data available (about chronic exposure effects, about variations in the health of the subject population, etc.) A greater safety factor would have to be incorporated to deal with greater uncertainty in the scientific data available Thus, a two-tier guideline offers more flexibility in dealing with scientific uncertainty, while a one-tier guideline would force a more conservative limit to cover all circumstances including the scientific uncertainties that exist

Issue: Controlled vs uncontrolled (applicability of two IEEE exposure tiers)

The current "controlled" and "uncontrolled" definitions are problematic, at least in the civilian sector, particularly since there are no procedures defined in the document to implement the "controlled" condition The new guidelines should offer direction for the range of controls to be implemented and the training required for those who knowingly will be exposed (e g workers), along the lines of the existing ANSI laser safety standards This essential element needs to be included for whatever limits are defined, be they one-tier or two-tier

For example, the OSHA position is that the "uncontrolled" level is strictly an "action" level which

indicates that there is a sufficiently high exposure (compared to the vast majority of locations) to merit an assessment to determine what controls and training are necessary to ensure persons are not exposed above the "controlled" limit. Many similar "action" levels are part of OSHA and public health standards. Should this interpretation be incorporated into the IEEE standard as a means to determine the need to implement a safety plan? [The laser standard has a multi-tiered (Class I, II, III, IV) standard which similarly requires additional controls for more powerful lasers to limit the likelihood of an excess exposure, even though the health effect threshold is the same.]

On the other hand, if it is determined that certain populations (due to their health status or age) are more susceptible to RF exposures, then a multi-tiered standard, applicable only to those specific populations, may be considered.

The ANSI/IEEE standard establishes two exposure tiers for controlled and uncontrolled environments. The following statement is made in the rationale (Section 6, page 23): "The important distinction is not the population type, but the nature of the exposure environment." If that is the case, consideration should be given to providing a better explanation as to why persons in uncontrolled environments need to be protected to a greater extent than persons in controlled environments. An uncontrolled environment can become a controlled environment by simply restricting access (e.g., erecting fences) and by making individuals aware of their potential for exposure. After such actions are taken, this means that the persons who previously could only be exposed at the more restrictive uncontrolled levels could now be exposed inside the restricted area (e.g., inside the fence) at controlled levels.

What biologically-based factor changed for these people? Since the ostensible public health reason for providing greater protection for one group of persons has historically been based on biological considerations or comparable factors, it is not clear why the sentence quoted above is valid.

Issue: Uncertainty factors

The uncertainties in the data used to develop the guideline should be addressed. An accepted practice in establishing human exposure levels for agents that produce undesirable effects is the application of factors representing each area of uncertainty inherent in the available data that was used to identify the unacceptable effect level. Standard areas of uncertainty used in deriving acceptable human dose for agents that may produce adverse (but non-cancer) effects include:

(1) extrapolation of acute effects data to chronic exposure conditions,
(2) uncertainty in extrapolating animal data to humans in prolonged exposure situations,
(3) variation in the susceptibility (response/sensitivity) among individuals,
(4) incomplete data bases,
(5) uncertainty in the selection of the effects basis, inability of any single study to adequately address all possible adverse outcomes.

If guidelines are intended to address nonthermal chronic exposures to intensity modulated RF radiation, then how could uncertainty factors be used, how would this use differ from the historical use of uncertainty factors in establishing RF radiation guidelines to limit exposure to acute or sub-chronic RF radiation to prevent heat-related effects?

There is a need to provide a clear rationale for the use of uncertainty factors.

Issue Intensity or frequency modulated (pulsed or frequency modulated) RF radiation

Studies continue to be published describing biological responses to nonthermal ELF-modulated and pulse-modulated RF radiation exposures that are not produced by CW (unmodulated) RF radiation. These studies have resulted in concern that exposure guidelines based on thermal effects, and using information and concepts (time-averaged dosimetry, uncertainty factors) that mask any differences between intensity-modulated RF radiation exposure and CW exposure, do not directly address public exposures, and therefore may not adequately protect the public. The parameter used to describe dose/dose rate and used as the basis for exposure limits is time-averaged SAR, time-averaging erases the unique characteristics of an intensity-modulated RF radiation that may be responsible for producing an effect.

Are the results of research reporting biological effects caused by intensity-modulated, but not CW exposure to RF radiation sufficient to influence the development of RF exposure guidelines? If so, then how could this information be used in developing those guidelines? How could intensity modulation be incorporated into the concept of dose to retain unique characteristics that may be responsible for a relationship between exposure and the resulting effects?

Issue Time averaging

Time averaging of exposures is essential in dealing with variable or intermittent exposure, e.g., that arising from being in a fixed location of a rotating antenna, or from moving through a fixed RF field. The 0.1 h approach historically used should be reassessed, but may serve this purpose adequately. Time averaging for other features of RF exposure is not necessarily desirable, however, and should be reevaluated specifically as it deals with modulation of the signal, contact and induced current limits, and prolonged, or chronic exposure. These specific conditions are discussed in a little more detail elsewhere.

If prolonged and chronic exposures are considered to be important, then there should be a reconsideration of the time-averaging practices that are incorporated into existing exposure guidelines and used primarily to control exposure and energy deposition rates in acute/subchronic exposure situations.

Issue: Lack of peak (or ceiling) limits for induced and contact current

A recent change in the IEEE guidelines allows for 6 minute, rather than 1 second, time-weighted-averaging for induced current limits. This change increases the concern about the lack of a peak limit for induced and contact currents. Will the limits for localized exposure address this issue, i.e., for tissue along the current path?

Issue: Criteria for preventing hazards caused by transient discharges

The existing IEEE recommendation states that there were insufficient data to establish measurable criteria to prevent RF hazards caused by transient discharges. If specific quantitative criteria are still not available, can qualitative requirements be included in the standard to control this hazard (e.g., metal objects will be sufficiently insulated and/or grounded, and/or persons will utilize sufficient insulating protection, such as gloves, to prevent undesirable transient discharge)?

ISSUE: Limits for exposure at microwave frequencies

Concerns have been expressed over the relaxation of limits for continuous exposures at microwave frequencies above 1500 MHz. The rationale provided in the current guideline (Section 6.8) references the fact that penetration depths at frequencies above 30 GHz are similar to those at visible and near infrared wavelengths and that the literature for skin burn thresholds for optical radiation "is expected to be applicable." The rationale then implies that the MPE limits at these high frequencies are consistent with the MPE limits specified in ANSI Z136.1-1986 for 300 GHz exposures. This is apparently the rationale for "ramping up" to the MPE limits for *continuous* exposure of 10 mW/cm^2 at frequencies above 3 GHz (controlled) or 15 GHz (uncontrolled). The rationale should be given as to why this ramp function has been established at relatively low microwave frequencies (i.e., 1500 MHz and above), rather than being implemented at higher frequencies that are truly quasi-optical. For example, one option could be two ramp functions, one beginning at 300 MHz, based on whole- or partial-body dosimetry considerations, and another at higher frequencies (say 30-100 GHz) to enable consistency with the laser standard. Such a revision should help reduce concern that the standard is not restrictive enough for continuous exposures at lower microwave frequencies where new wireless applications for consumers could make this an issue in the future.

Issue: Replication/Validation

Published peer-reviewed studies that have been independently replicated/validated should be used to establish the adverse effects level from which exposure guidelines are derived. The definition of "replicated/validated" should not be so restrictive to disallow the use of a set of reports that

are scientifically valid but are not an exact replication/validation of specific experimental procedures and results.

Peer-reviewed, published studies that may not be considered to be replicated/validated, but are well done and show potentially important health impacts provide important information regarding uncertainties in the data base used to set the adverse effect level (e.g., incomplete data base).

Issue: Important Health Effects Literature Areas.

Documentation should be provided that the literature review process included a comprehensive review of the following three areas:

1) long-term, low-level exposure studies (because of their importance to environmental and chronic occupational RFR exposure),
2) neurological/behavioral effects (because of their importance in defining the adverse effect level in existing RFR guidelines); and
3) micronucleus assay studies (because of their relevance to carcinogenesis).

Issue: Compatibility of RFR guidelines

Compatibility of national and international RFR guidelines remains a concern. It is important for the IEEE Committee to address this issue by identifying and discussing similarities and differences in a revised IEEE guideline and other RFR guidelines. Compatibility/noncompatibility issues could be discussed in the revised IEEE guideline or as a companion document distributed at the time the revised IEEE guideline is released to the public.

EXHIBIT B

February 11, 2001

Vermont House of Representatives
Committee on natural Resources
State House
Montpeleir, VT

and

Central Vermont Regional Development Planning Commission
26 State Street
Montpelier VT

Dear Committee Members,

I am writing to express my opinion and concern on the possible health effects of exposure to radiofrequency radiation from wireless transmitters (base stations).

The level (intensity) of radiation from a transmitters that one would be exposed to is very low, mainly because of the distance from the transmitter. The level is generally considered to be harmless. Most research in this area deals with radiation of much higher levels. However, some recent studies have suggested that exposure to similar in intensity to those from cellular phone base station transmitters is not completely safe. The following is a partial list of biological studies on low level effects (within the levels of exposure less than 200 ft from a transmitter):

(1) Persson et al. (1997): Change in blood-brain-barrier at a specific absorption rate (SAR) of 0.0004 W/kg. The blood-brain-barrier protects the brain from exogenous chemicals. [Blood Brain Barrier permeability in rat exposed to electromagnetic fields used in wireless communication, Wireless Network 3:455-461, 1997]

(2) Velizarov et al. (1999): Change in cell proliferation (multiplication) at a SAR range of 0.000021 - 0.0021 W/kg. [The effects of radiofrequency fields on cell proliferation are non-thermal, Bioelectrochemistry and Bioenergetics 48:177-180, 1999]

(3) Magnras & Xenos (1997): Decrease in reproductive functions at intensities of 160-1053 nW/sq. cm. [RF radiation-induced changes in the prenatal development of mice. Bioelectromagnetics 18:455-461, 1997]

(4) Ray & Behari (1990): Decrease eating and drinking behavior at a SAR of 0.0317 W/kg [Physiological changes in rats after exposure to low levels of microwaves. Radiation Research 123:199-202, 1990]

(5) Dutta et al. (1989): Change in calcium efflux from cells at SAR of 0.05 - 0.005 W/kg. Calcium is an important chemical that regulates cell functions. [Radiofrequency radiation induced calcium ion efflux enhancement from human and other neuroblastoma cells in culture, Bioelectromagnetics 10:197-202, 1989]

(6) Phillips et al. have observed DNA damage in human cells exposed to very low intensity cellular telephone signals (0.0024 -0.024 W/kg, 2 -21 hr exposure). [DNA damage in Molt-4 lymphoblastoid cells exposed to cellular telephone radiofrequency fields in vitro. Bioelectrochemistry and Bioenergetics 45:103-110, 1998]

(7) De Pomerai et al. reported molecular stress responses in cells exposed at a SAR of 0.001 W/kg. [Non-thermal heat shock response to microwaves, Nature 405:417-418, 2000]

Furthermore, when considering the health effect of radiation from wireless transmitters, one has to consider the effect of long term exposure. People who live close to transmitters are constantly being exposed to the radiation for months or years. Even though the level is low, it would matter if the effects of radiofrequency radiation turn out to be cumulative (i.e., add up over time). Small doses cumulate over a long period of time will eventually lead to harmful effects. Therefore, exposure of the general public to radiofrequency radiation from wireless transmitters should be limited to a minimal.

Sincerely,

Henry Lai, Ph.D.
Research Professor
Department of Bioengineering, Box 357962
University of Washington
Seattle, WA 98195
USA

Summary of EPA Budget and Staffing for RF Radiation Activities from FY1990–2000

(Extramural Dollars Only)

FY	90	91	92	93	94	95	96	97	98	99	00
FTE	2.3	2.2	2.1	2.1	2	2	0.5	0.5	0.5	0.5	0.5
$(K)	$0	$40	$25	$543[a]	$73[b]	$140[c]	$0	$0	$25[d]	$0	$0

[a] Includes grant funds ($510,000) under EPA/NIEHS Interagency Agreement DW75935939.

[b] Includes funds ($50,000) for Cooperative Agreement (CX823714) with the National Council on Radiation Protection and Measurements (NCRP).

[c] Includes funds ($50,000) for Cooperative Agreement (CX823714) with NCRP.

[d] $25K completes total funding ($125,000) for Cooperative Agreement (CX823714) with NCRP.

EXHIBIT D

Comparing Standards for general public RF exposure levels
(900 and 1800 MHz are the two main existing UK mobile phone bands)

Prepared by Alasdair Philips, Technical Director, Powerwatch, June 2000

Multiple signals should be added together, as the square root of the sum of squares of the individual signals.

Figures in **bold** in the table below are the main units given in the guidance.

'Near-field' levels next to a working mobile phone handset vary enormously depending on the antenna design but can often exceed the electric field and power density levels set in the general exposure standards.

General Public Levels	Frequency MHz	E field V/m	Power W/m^2	Power μ W/cm^2
NRPB, 1993 (Current UK Investigation Levels)	900 1800	112 194	33 100	3300 10000
FCC OET65 1997-01 (USA) based on ANSI/IEEE C95 1-1992	900 1800	47 61	6 10	600 1000
Canadian Safety Code 6 (SC6) 1995	900 1800	47 61	6 10	600 1000
ICNIRP, 1998 (recognised by WHO) CENELEC, 1995 (EU)	900 1800	41 58	4.5 9	450 900
Australia 1988 (under review)	900 / 1800	27	2	200
Two USA research bases (1995)	30 - 100000	19	1	100
Poland (non-stationary people) (stationary people)	300 - 300000	19 6	1 0.1	100 10
Russia 1988 (general public)	300 - 300000	6	0.1	10
Italy, Decree 381 (1999)	30 - 30000	6	0.1	10
Toronto Health Board 2000, proposal based on SC6/100	900 1800	5 6	0.06 0.1	6 10
Swiss Ordinance ORNI (for base stations) From 1st Feb 2000	900 1800	4 6	not specified	not specified
EU & UK EMC Regulations equipment suscept test level (domestic & comm)	30 - 2000	3	not specified	not specified
Typical max in public areas near base station masts (can be much higher)	900 & 1800	2	0.01	1
City of Salzburg, Austria, 1998	300 - 300000	0.62	0.001	0.1
Dr Cherry (NZ) proposal for now	300 - 300000	0.28	0.0002	0.02
Average US (EPA 1980)-----> City Dweller max (FCC 1999)----->	approx 30 - 300000	< 0.13 < 2	< 0.00005 < 0.01	< 0.005 < 1
Broadband 'natural' background	300 - 3000	< 0.00003	< 0.00000001	< 0.000001
** Typical, close to handset antenna	900 & 1800	50 - 300	2 - 50	200 - 5000