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Public Comment Submission: HHS RFI on Electromagnetic Fields (EMFs) and Wireless Radiation Exposure

In Response to:

U.S. Department of Health and Human Services (HHS)
Request for Information on Electromagnetic Fields (EMFs), Radiofrequency (RF)
Radiation, and Wireless Radiation Exposure
Docket No.: HHS-OASH-2026-0397
FR Doc.: 2026-19252

Submitted by:

Chung-Kwang (C-K.) Chou, Ph.D.
C-K. Chou Consulting
October 19, 2026

Introduction

My name is **Chung-Kwang (C-K.) Chou**, and I have dedicated my career to researching electromagnetic field (EMF) safety and its medical applications. I am submitting the following formal comments in response to the specific questions outlined in this Request for Information (RFI). Please note that these comments are submitted strictly in my personal capacity as an independent scientist; they represent my individual professional views and do not necessarily reflect the positions of my previous employers or any organizations I have served.

Public Experiences and Reported Potential Adverse Health Effects

Question 2: Researcher Credentials & Experience

I am submitting these comments as an active researcher in the bioelectromagnetics field since 1971. The first attached file (**Attachment 1**) provides a short biography outlining my education, employment history, committee service, and professional honors. My institutional and standards development experience is structured as follows:

Period	Organization / Institution	Role / Focus
1977–1985	University of Washington	Faculty Member, Dept. of Rehabilitation Medicine & Center for Bioengineering
1985–1998	City of Hope National Medical Center	Research Scientist & Director, Dept. of Radiation Research
1998–2013	Motorola / Motorola Solutions	Corporate EME Research Lab Director & Chief EME Scientist
1979–Present	IEEE Standards Committees	Development of EMF safety-related standards

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2014–
Present

Independent Consultant

International advisor on EMF safety issues

Question 3: Experimental Models, Frequencies, and Clinical Observations

Throughout my research career at the University of Washington and the City of Hope National Medical Center, I conducted extensive *in vitro*, *in vivo*, and human studies to evaluate the biological effects of electromagnetic energy.

- **Experimental Models:** Evaluated suspended cells, monolayered cells, frogs, mice, rats, guinea pigs, rabbits, cats, pigs, monkeys, humans, and various bird species (including parakeets, pigeons, chickens and turkeys).
- **Frequency Bands:** Experimental frequencies spanned the radiofrequency (RF) spectrum from the LF to the SHF bands, utilizing both continuous-wave and pulse-modulated exposures. This work has direct translational applications for safety protocols across telecommunications, industrial sectors, military operations, and medical technologies.
- **Historical Reference: Attachment 2** outlines my core research contributions up to 2006¹, the year I received the D'Arsonval Award, the highest award bestowed upon a member of the Bioelectromagnetics Society.

Clinical & Injury Observations:

1. **Microwave Hyperthermia:** During clinical trials at both institutions, I observed that oncology patients undergoing RF hyperthermia treatments (ISM band) occasionally sustained minor localized burns from excessive heating. In the context of life-threatening cancer treatments, these localized thermal side effects are minor and clinically manageable compared to the risks of tumor progression.
2. **Occupational RF Injury:** I personally knew a broadcast engineer who suffered a severe, non-medical RF exposure injury. The accident occurred due to high-power RF energy exposure to the whole body while he was servicing FM broadcast antennas on a Chicago skyscraper.
3. **Consumer Appliance Malfunction:** I evaluated a patient in the Rehabilitation Medicine Clinic at the University of Washington who sustained a severe hand nerve injury due to a commercial microwave oven (2450 MHz, 1 kW) operating with a faulty interlock safety mechanism. Both accidental cases demonstrated profound tissue damage due to whole-body or local exposures caused exclusively by extreme RF thermal heating.
4. **Auditory Correspondence:** Following my published findings on the microwave hearing effect, I received periodic correspondence from individuals reporting auditory disturbances or perceived voices which they attributed to environmental RF radiation. However, because these individuals could not provide verifiable technical exposure or dosimetry parameters, these claims could not be scientifically or empirically evaluated.

Question 4: Mechanisms, Replication Challenges, and Dosimetry Literacy

I completed my Ph.D. dissertation, "*The effects of electromagnetic fields on the nervous system*," at the University of Washington in 1975. This doctoral research was funded by a U.S. Food and Drug Administration (FDA) grant to investigate reports regarding RF exposure at the American Embassy in Moscow, alongside a National Science Foundation (NSF) grant to study the microwave auditory effect.

¹ C-K. Chou. Thirty-Five Years in Bioelectromagnetics Research. Bioelectromagnetics 28:3-15, 2007.

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- **Refuting Non-Thermal Claims:** My graduate work demonstrated that the central nervous system effects published by Soviet scientists in 1964 were artifacts of uncontrolled temperature rises (i.e., a thermal effect) rather than genuine non-thermal effects.
- **RF Hearing Mechanism:** Through the successful recording of cochlear microphonics in guinea pigs and cats, I provided indisputable experimental evidence that radiofrequency (RF) hearing is mediated by hair cell vibrations driven by thermoelastic expansion pressures inside the head. This physical mechanism aligned perfectly with the acoustic pressure waves measured in a water tank by Dr. Kenneth Foster at the University of Pennsylvania, directly refuting alternative hypotheses that pulsed microwave hearing resulted from the direct electrical stimulation of auditory nerves. While RF hearing in humans is a well-established biological effect, it carries no known adverse health consequences. The RF-induced sounds are like other common sounds. Consequently, this microwave pulse-induced auditory effect has been explicitly classified as non-deleterious in standard limits ranging from IEEE C95.1-1991 through C95.1-2019. Similarly, while the ICNIRP 1998 guidelines originally maintained separate limits for auditory effects, these were removed in the ICNIRP 2020 guidelines to align with the IEEE C95.1 standard to protect against established adverse health effects.

Throughout my postgraduate career, my research results repeatedly confirmed thermal mechanisms. In the few instances where I initially suspected non-thermal effects, rigorous follow-up analysis invariably revealed subtle experimental artifacts or hidden temperature-control issues. These experiences underscored that bioelectromagnetics requires deep, dual expertise in both biology and engineering. Without cross-disciplinary collaboration, studies easily yield misleading conclusions. Bioelectromagnetic research teams must have these qualifications.

To bridge this educational gap, during my tenure as Chairman of the IEEE Committee on Man and Radiation (COMAR) in the late 1990s, I led the committee in drafting a tutorial paper on RF dosimetry tailored specifically for epidemiologists and biologists, published in *Bioelectromagnetics* in 1996 (**Attachment 3**)².

To address the complexities of proper experimental design, I published two subsequent review papers outlining these systemic scientific controversies:

- **Attachment 4 (*Electromagnetic Biology and Medicine*, 2015)**³: I emphasized that researchers have an obligation to look beyond a mere observed effect and actively identify the underlying biophysical mechanism. Without clarifying the mechanism, the research remains incomplete.
- **Attachment 5 (*International Journal of Environmental Research and Public Health*, 2022)**⁴: This paper analyzed the root causes of the multi-decade EMF safety controversy, which stems primarily from the quality of research reports. The scientific validity of a report relies on distinguishing proven facts from speculative opinions. My enduring hope for the field is a shift toward objective facts and away from unsubstantiated opinions.

² Chou, C.K., H. Bassen, J. Osepchuk, Q. Balzano, R. Petersen, M. Meltz, R. Cleveland, J.C. Lin, L. Heynick. Radio Frequency Electromagnetic Exposure: A Tutorial Review on Experimental Dosimetry. *Bioelectromagnetics* 17(3):195-208, 1996.

³ Chou, C-K. A need to provide explanations for observed biological effects of radiofrequency exposure. *Electromagnetic Biology and Medicine*, 34(3):175-179, 2015.

⁴ C-K. Chou. Controversy in Electromagnetic Safety. *International Journal of Environmental Research and Public Health*. 2022, 19, 16942. <https://www.mdpi.com/1660-4601/19/24/16942>

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Exposure Standards and Risk Assessment

Question 5: Regulatory History and Harmonization

The regulatory history of RF exposure safety originated within the U.S. military following World War II, primarily through the systematic investigations of the Tri-Service Program in the 1950s and 1960s. Subsequently, the Department of the Navy and the IEEE co-developed the first formal RF exposure limits, published as USAS C95.1-1966. Since then, the IEEE C95.1 standard has undergone six major revisions, culminating in the current **IEEE C95.1-2019** edition. In 1996, the FCC adopted a combination of ANSI C95.1-1992 and NCRP Report 86 (1986) as its regulatory framework.

Internationally, the International Commission on Non-Ionizing Radiation Protection (ICNIRP) has developed independent guidelines since 1998. The current ICNIRP (2020) guidelines closely align with IEEE C95.1-2019; both frameworks are designed to protect against all substantiated or scientifically established adverse health effects. While most countries adopt ICNIRP guidelines under World Health Organization (WHO) recommendations, some follow the FCC lead. A few nations maintain exceptionally low limits derived from historical Soviet methodologies. The Soviet approach dictates that the human body should not have to adapt to any RF-induced biological effect, even if completely non-adverse and non-pathological. This represents a fundamental philosophical departure from the rigorous risk-assessment frameworks utilized by the IEEE and ICNIRP⁵.

Having served on the IEEE standards committee since 1979 and having completed a 20-year tenure as the Chairman of the International Committee on Electromagnetic Safety (ICES) TC95—where I oversaw the development and publication of both the C95.1-2005 and C95.1-2019 standards—I strongly recommend as an independent scientist that the United States government fully adopt the latest **IEEE C95.1-2019** standard.

Question 6: Global Expert Consensus

As documented in the IEEE ICES Expert Reviews Archive⁶, global governments and independent expert panels have issued 113 comprehensive statements concerning the health effects and safe exposure thresholds of RF energy. Across this massive body of literature spanning from 2010 to 2026, there is no established scientific evidence that exposure to RF energy below current limits causes any adverse health effects. This safety consensus holds true under both IEEE standards and ICNIRP guidelines.

Measuring Human Exposure and Public Health Surveillance

Question 7: Compliance and Assessment Standards

The standard frameworks governing compliance measurements and computational dosimetry for individuals and populations are established by the following active global standards:

⁵ Repacholi M., Grigoriev Y., Buschmann J., Pioli C. “Scientific basis for the Soviet and Russian radiofrequency standards for the general public.” *Bioelectromagnetics*, 33, 623 - 633, 2012.

⁶ <https://sagroups.ieee.org/ices/expert-reviews/>

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Standard Identifier	Developing Body	Title
IEEE C95.3-2021	IEEE ICES TC95	Recommended practice for measurements and computations of electric, magnetic, and electromagnetic fields (0 Hz to 300 GHz).
IEEE/IEC 62209-1528: 2020	IEC TC106 / IEEE ICES TC34	Dual-logo standard for assessing the Specific Absorption Rate (SAR) from hand-held and body-mounted wireless devices (4 MHz to 10 GHz).
IEEE/IEC 62704-1: 2017	IEC TC106 / IEEE ICES TC34	IEC/IEEE International Standard for Determining the Peak Spatial Average Specific Absorption Rate (SAR) in the Human Body from Wireless Communications Devices, 30 MHz - 6 GHz. Part 1: General Requirements for using the Finite Difference Time Domain (FDTD) Method for SAR Calculations.
IEEE/IEC 62704-2:2017	IEC TC106 / IEEE ICES TC34	Determining the peak spatial-average specific absorption rate (SAR) in the human body from wireless communications devices 30 MHz to 6 GHz – Part 2: Specific requirements for finite difference time domain (FDTD) modelling of exposure from vehicle mounted antennas.
IEEE/IEC 62704-3:2017	IEC TC106 / IEEE ICES TC34	Determining the peak spatial-average specific absorption rate (SAR) in the human body from wireless communications device 30 MHz to 6 GHz – Part 3: Specific requirements for using the finite difference time domain (FDTD) method for SAR calculations of mobile phones.
IEEE/IEC 62704-4:2020	IEC TC106 / IEEE ICES TC34	Determining the peak spatial-average specific absorption rate (SAR) in the human body from wireless communication devices 30 MHz to 6 GHz – Part 4: General requirements for using the finite element method (FEM) for SAR calculations.
IEC 62232:2025	IEC TC106	Determination of RF field strength, power density, and SAR in the vicinity of radiocommunication base stations.
IEC/IEEE 63195-1: 2022	IEC TC106 / IEEE ICES TC34	IEEE/IEC International Standard Assessment of power density of human exposure to radio frequency fields from wireless devices in close proximity to the head and body (frequency range of 6 GHz to 300 GHz)--Part 1: Measurement procedure
IEC/IEEE 63195-2: 2022	IEC TC106 / IEEE ICES TC34	IEC/IEEE International Standard - Assessment of power density of human exposure to radio frequency fields from wireless devices in close proximity to the head and body (frequency range of 6 GHz to 300 GHz)--Part 2: Computational procedure
IEC/IEEE 63184: 2025	IEC TC106 / IEEE ICES TC34	IEC/IEEE International Standard - Assessment methods of the human exposure to electric and magnetic fields from wireless power transfer systems - models, instrumentation, measurement and computational methods and procedures (frequency range of 3 kHz to 30 MHz)

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Question 8: Instrumentation Adequacy

Numerous commercially available instruments can accurately determine exposure levels in both occupational and residential environments. The accuracy and precision of these modern devices are fully adequate for assessing compliance in accordance with current IEC and IEEE standards.

Question 9: Risk Communication & Public Access to Data

Consumers have the right to access scientific data regarding products that emit RF energy. Because fear often stems from a lack of clear information, proactive public communication is vital for reducing unnecessary anxiety and concerns. Without transparency, the nocebo effect can take hold, creating a genuine risk to public health. Recognizing this, the Japanese government has supported the Japan EMF Information Center (JEIC) since July 2008 to foster risk communication by providing neutral, scientifically verified data.

The National Council on Radiation Protection and Measurements (NCRP) is a congressionally chartered, nonprofit organization of experts dedicated to evaluating scientific data and formulating radiation protection guidance for the United States. Recently, the NCRP launched a dedicated online resource designed to disseminate scientific facts regarding non-ionizing radiation, with a specific focus on the RF energy powering mobile devices and wireless technologies. The platform synthesizes the findings of high-quality, peer-reviewed literature and provides rigorous yet accessible explanations of wireless infrastructure operations and the formulation of exposure limits.⁷

Question 10: Health Surveillance Cost-Effectiveness

After more than 70 years of research, current scientific data has identified no established adverse health effects from RF exposure below safety thresholds. Today, mobile phones represent the primary source of individual RF exposure. Despite a massive, multi-decade surge in global mobile phone usage, population-based medical registries show no corresponding rise in brain cancer incidence. This divergence demonstrates that conventional public health surveillance systems remain the most efficient mechanism for monitoring population safety. While these baseline surveillance networks are essential for tracking agents with verified health hazards, implementing dedicated, RF-specific tracking registries is not cost-effective.

Question 11: Vulnerable Populations & Electromagnetic Hypersensitivity (EHS)

To ensure a robust safety margin, IEEE Std C95.1-2019 incorporates conservative reduction factors designed specifically to protect vulnerable populations, including children, pregnant women, the elderly, and medical patients. Decades of research provide no proven evidence that these established thresholds are inadequate. While the standard acknowledges that its thresholds may not prevent electromagnetic interference (EMI) with certain medical devices, manufacturers have significantly improved product immunity and shielding over the years. Nevertheless, patients with implants must follow the guidance of their medical professionals and device manufacturers.

Extensive double-blind investigations into electromagnetic hypersensitivity (EHS) have found no verified causal link between reported physical symptoms and EMF exposure. Because the root cause of these symptoms remains an unresolved medical issue, individuals experiencing

⁷ <https://non-ionizing.ncrponline.org/>

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them are highly encouraged to participate in clinical studies to help determine the true underlying trigger.

Question 12: Expert Panel Review Consistency

(Refer to the comprehensive statements and repository details provided in response to Question 6 above).

Existing Evidence

Question 13: Residential vs. Personal Device Exposure Levels

Numerous peer-reviewed studies have measured environmental RF exposure levels in residential zones. Both IEEE standards and ICNIRP guidelines mandate the summation of exposures across all frequency bands and applications to determine compliance. Except for restricted locations directly adjacent to major sources—such as rooftops with cellular base station antennas—typical everyday exposures remain orders of magnitude below safety thresholds. For the general public, the highest individual RF exposure originates from personal wireless devices operating close to the body, not from ambient infrastructure; the exposure levels from personal wireless devices are below the FCC limit.

Question 14: Anthropogenic Impacts on Flora and Fauna

In my research spanning various taxa—from amphibians to birds and mammals, the observed biological impacts are primarily thermal in nature, with data from these animal models subsequently translated to human health contexts. In contrast, flora exists in environments characterized by vast ambient temperature variations. To contextualize these cross-species impacts, I recommend referencing the comprehensive systematic map published by researchers at the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), which establishes a critical baseline on this topic:

Brzozek, C., Mate, R., Bhatt, C. R., Loughran, S., Wood, A. W., & Karipidis, K. (2024). Investigating the impact of anthropogenic radiofrequency electromagnetic fields on animals and plants in the environment: analysis from a systematic map. *International Journal of Environmental Evidence*, 81(5), 2343–2358.

Question 15: Distance, Cumulative Emissions, and Environmental Safety

RF exposure safety is primarily a function of distance. Just as one avoids direct contact with an open flame while cooking, individuals must maintain appropriate distances from localized high-power RF sources. Because RF is radiated energy, the local intensity of the field determines its biological effects.

Both the IEEE C95.1 standard and the ICNIRP guidelines are scientifically developed to protect the general public and occupational workers from established adverse health effects. Implementing appropriate compliance assessment methods ensures that residential and workplace environments remain safely within these limits. Regardless of cumulative emissions or local antenna density, public safety is assured as long as the total, combined exposure levels remain well below these conservative thresholds—a safety framework validated by six decades of robust critical scientific reviews.

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Federal Research Priorities

Question 16: Research Prioritization for EHS

There are always avenues for further scientific research. The question of electromagnetic hypersensitivity (EHS) should remain high on the federal research priority list because people are suffering from these symptoms. Without identifying the actual root cause of their distress, it remains impossible to develop effective medical treatments or provide meaningful clinical relief.

Question 17: Federal Policy Harmonization

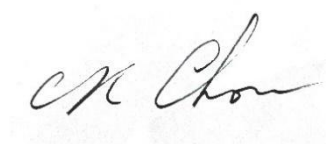
Federal agencies should maintain consistent policies and regulations on EMF exposure based strictly on the best available, peer-reviewed scientific evidence. Because EMF safety is fundamentally a scientific issue rather than a political one, it must be addressed through rigorous experimental and scientific means. Furthermore, as a global technological challenge, national frameworks should be fully harmonized with the World Health Organization (WHO) position, implementing standardized exposure limits and compliance assessment methods worldwide.

Question 18: Systematic Review Methodologies

The scientific literature review process must go beyond a simple "vote-counting" tally of positive or negative papers. Distinct from other scientific disciplines, studying the biological effects of electromagnetic fields is uniquely complicated; unfortunately, a significant portion of the published literature consists of low-quality studies with poor dosimetry control. Reviews must strictly weight studies based on their methodological and dosimetric rigor, making systematic reviews essential to properly evaluate scientific validity. Reflecting this necessity, the World Health Organization (WHO) has implemented a policy requiring the use of systematic reviews for all health-related issues.

Final Remarks

I appreciate the opportunity to contribute my lifetime of experience to this discussion. As progress in technology continues to enhance human life, it is essential for scientists to ensure that safety is never compromised. Scientists must maintain absolute rigor and accuracy in reporting their findings, ensuring that experimental mistakes are minimized and caught at the foundational level of research. Let us make sure that what we do is right the first time, and if an error is made, have the professional courage to admit and correct it promptly. Scientists should aspire to explore the unknown through sound, well-planned research, rather than creating confusion through the reporting of erroneous conclusions that take years to correct. Concurrently, the government has a responsibility to protect its citizens by establishing regulations based strictly on the most solid scientific evidence and supporting globally harmonized exposure limits.



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Attachments:

1. Short biography
2. C-K. Chou. Thirty-Five Years in Bioelectromagnetics Research. Bioelectromagnetics 28:3-15, 2007.
3. Chou, C.K., H. Bassen, J. Osepchuk, Q. Balzano, R. Petersen, M. Meltz, R. Cleveland, J.C. Lin, L. Heynick. Radio Frequency Electromagnetic Exposure: A Tutorial Review on Experimental Dosimetry. Bioelectromagnetics 17(3):195-208, 1996.
4. Chou, C-K. A need to provide explanations for observed biological effects of radiofrequency exposure. Electromagnetic Biology and Medicine, 34(3):175-179, 2015.
5. C-K. Chou. Controversy in Electromagnetic Safety. International Journal of Environmental Research and Public Health. 2022, 19, 16942. <https://www.mdpi.com/1660-4601/19/24/16942>