APPENDIX A

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of:

Reassessment of Federal Communications Commission Radiofrequency Exposure Limits and Policies	)	ET Docket No. 13-84 (Termination order remanded)
Targeted Changes to the Commission's Rules Regarding Human Exposure to Radiofrequency Electromagnetic Fields	)	ET Docket No. 19-226

PETITION TO IMPLEMENT D.C. CIRCUIT JUDGMENT AND MANDATE, REOPEN *NOTICE OF INQUIRY,* AND PERFORM TASKS ORDERED BY THE COURT,

AND

REQUEST FOR PROMPT ADMINISTRATIVE ACTION

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SELECTED GLOSSARY OF TERMS

Department of Health and Human Services ("HHS"): A cabinet level United States federal agency tasked with enhancing and protecting the health and well-being of Americans. It oversees numerous health-related agencies and offices, including the Food and Drug Administration ("FDA"), National Institutes of Health ("NIH") which conducts medical research, Centers for Disease Control and Prevention ("CDC") and others.

Environmental Protection Agency ("EPA"): A United States federal agency established to protect human health and the environment. Its primary role is to develop and enforce environmental regulations, conduct research, and provide grants to support environmental protection efforts. In the 1970s and 1980s the EPA occasionally funded or collaborated on research into the biological and other health effects of non-ionizing radiation, including microwave and radar radiofrequencies. This research was effectively and almost entirely defunded in the 1990s.[1]

Federal Communications Commission ("FCC" or the "Commission"): An independent United States government agency that regulates inter-state and international communications, including wireless and satellite. It was established by the Communications Act of 1934 and mainly functions to promote competition and innovation in communications services. It sets and enforces various human radiofrequency exposure standards and limits often as a condition for wireless operators to legally hold their rights to utilize spectrum. It also regulates the radiofrequency emission levels of wireless devices and infrastructure. It is not a health care agency.

Food and Drug Administration ("FDA"): A branch of the Department of Health and Human Services ("HHS") responsible for protecting and promoting public health by regulating food, drugs, medical devices, tobacco products, and other items. The FDA regulates radiofrequency radiation with the aim to ensure products do not emit hazardous and unnecessary radiation.

Internet of Things ("IoT"): A network of mostly wireless interconnected devices, objects, or "things" that can collect and exchange data over a network, often without requiring human-to-human or human-to-computer interaction.

Make America Healthy Again ("MAHA") Commission: Established by Executive Order 14212 on February 13, 2025, and chaired by Department of HHS Secretary Robert F. Kennedy Jr., the commission's primary goal is to address the rising rates of chronic diseases in the United

[1] *How the EPA Lost Its Role in Regulating RF Radiation: A Historical Deep Dive*, RF Safe (Feb. 2, 2025) https://www.rfsafe.com/articles/cell-phone-radiation/how-the-epa-lost-its-role-in-regulating-rf-radiation-a-historical-deep-dive.html. *See also*: "On July 8, 2020, Lee Ann B. Veal Director, Radiation Protection Division Office of Radiation and Indoor Air, Environmental Protection Agency of the United States of America confirmed that they have no funded mandate regarding wireless radiofrequency matters and that they are not aware of any developed safety limits or research reviews related to impacts of wireless on birds bees and the environment." EHT, *EPA admits no RF research review since 1984, no Congressional funding for RF study, no exposure guidelines exist for trees or wildlife*, Smart Meter Harm (July 11, 2020), https://smartmeterharm.org/2020/11/07/epa-admits-no-rf-research-review-since-1984-no-congressional-funding-for-rf-matters-no-exposure-guidelines-for-trees-or-wildlife/.

States, particularly among children, by investigating potential contributing factors and recommending policy changes.[2]

Radiofrequency ("RF"): "That group of electromagnetic energy whose wavelengths are between the audio and the light range. Electromagnetic waves transmitted usually are between 500 KHz and 300 GHz."[3]

Radiofrequency Device: "Any device which in its operation is capable of emitting radiofrequency energy by radiation, conduction, or other means."[4]

Radiofrequency Spectrum: "Although the RF spectrum is formally defined in terms of frequency as extending from 0 to 3000 GHz, for purposes of the FCC's exposure guidelines, the frequency range of interest in 300 kHz to 100 GHz."[5]

RF "Hot Spot": "A highly localized area of relatively more intense radio-frequency radiation that manifests itself in two principal ways: (1) The presence of intense electric or magnetic fields immediately adjacent to conductive objects that are immersed in lower intensity ambient fields (often referred to as re-radiation), and (2) Localized areas, not necessarily immediately close to conductive objects, in which there exists a concentration of RF fields caused by reflections and/or narrow beams produced by high-gain radiating antennas or other highly directional sources. In both cases, the fields are characterized by very rapid changes in field strength with distance. RF hot spots are normally associated with very nonuniform exposure of the body (partial body exposure). This is not to be confused with an actual thermal hot spot within the absorbing body."[6]

Satellite Megaconstellation: A "group of many satellites that work together for the purpose of delivering broadband Internet access. Megaconstellations can comprise hundreds or even thousands of satellites. The first megaconstellation satellites were launched in 2019, and, as of 2025, more than half of active satellites are part of a megaconstellation."[7]

Specific Absorption Rate ("SAR"): "A measure of the rate of energy absorbed by (dissipated in) an incremental mass contained in a volume element of dielectric materials such as biological tissues. SAR is usually expressed in terms of watts per kilogram (W/kg) or milliwatts per gram (mW/g). Guidelines for human exposure to RF fields are based on SAR thresholds where adverse biological effects may occur. When the human body is exposed to an RF field, the SAR

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[2] *See* Exec. Order No. 14212, 90 FR 9833 (Feb. 13, 2025), https://www.federalregister.gov/documents/2025/02/19/2025-02871/establishing-the-presidents-make-america-healthy-again-commission.
[3] *Radio Frequency*, Newton's Telecom Dictionary (19th ed. 2003).
[4] Radiofrequency device defined, 47 C.F.R. § 2.801 (1989), https://www.law.cornell.edu/cfr/text/47/2.801.
[5] FCC, OET Bull. No. 65, *Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields* (1997), https://transition.fcc.gov/oet/info/documents/bulletins/oet65/oet65.pdf at 4.
[6] Id. at 5.
[7] Erik Gregersen, *Megaconstellation*, Encyclopedia Britannica (May 5, 2025), https://www.britannica.com/technology/megaconstellation. *See generally* Scott Millwood, *The Urgent Need for Regulation of Satellite Mega-constellations in Outer Space* (2023) for additional information about satellite mega-constellations.

experienced is proportional to the squared value of the electric field strength induced in the body."[8]

Specific Anthropomorphic Mannequin ("SAM"): A standardized anatomical model of a human head used for SAR measurement.[9] The SAM model used during SAR testing represents a 220-pound male with a 12-pound head.[10]

[8] FCC, OET Bull. No. 65, *supra* note 5 at 5.
[9] Wolfgang Kainz et al., *Dosimetric comparison of the specific anthropomorphic mannequin (SAM) to 14 anatomical head models using a novel definition for the mobile phone positioning*, 50(14) Physics Med. & Biology 3423 (2005), https://doi.org/10.1088/0031-9155/50/14/016.
[10] "…it is very hard to understand why the FCC allows the use of a large SAM model of dimensions derived from the 90th percentile head size of the U.S. Military recruits for psSAR compliance testing against safety guidelines. Furthermore, the FCC-accepted SAM model has a tapered smooth plastic spacer instead of actual tissue pinna which can artificially separate the radiofrequency radiation source of the mobile phone by up to 10 millimeters at some locations resulting in an underestimation of both 1- and 10-g psSAR for male heads and for children and women by two or more times." Om P. Gandhi, *Yes the Children Are More Exposed to Radiofrequency Energy From Mobile Telephones Than Adults*, 3 IEEE Access 985, 987 (2015), https://doi.org/10.1109/ACCESS.2015.2438782.

INTRODUCTION

Pursuant to 47 C.F.R. § 1.1, the ("EHT") petitions and requests that the Commission promptly comply with the judgment and mandate, issued on October 5, 2021 by the United States Court of Appeals for the District of Columbia Circuit in No. 20-1025, EHT v. FCC, 9 F.4th 893 (2021) (hereafter "EHT v. FCC").

Nearly four years have passed since the D.C. Circuit (hereafter, the "Court") held that the Commission acted arbitrarily and capriciously in its failure to provide reasoned decision making for maintaining its decades-old RF radiation exposure limits—limits which fail to protect against the well-documented biological harms of RF radiation exposure to human health, flora, and fauna.[11] These harms stem from a wide variety of sources, including, but not limited to, cell phones, 5G networks, Wi-Fi networks, satellite mega-constellations, utility management meters, and wireless headsets. It is past time for the Commission and the FDA to encourage the wireless industry to compete on radiation safety. The automobile industry once resisted and then embraced competing on safety.[12] The wireless industry, as guided by regulators and in

[11] EHT v. FCC, 9 F.4th at 903, 908-09.
[12] *See*, e.g., the below Volvo print advertisement from 1973. Source: Volvo Cars.

accordance with the public interest, needs to promote products and services that possess safety features and which reduce radiation exposure and thus reduce the biological and other harms now well established as being caused by wireless radiation. It is also long past time for the United States to update its RF radiation exposure limits to align with more protective standards set by countries with lower and safer exposure thresholds.

Subsequent to the Court's October 5, 2021 mandate, several material developments have heightened the urgency for prompt FCC action in response to the Court's directives, including, but not limited to:


IT SHOULDN'T TAKE AN ACT OF CONGRESS TO MAKE CARS SAFE.

Volvo was committed to safety long before it became mandatory.

In 1956, for example, we installed padded dashboards: 12 years before the government insisted on them.

In 1959, Volvo became the first mass-produced car in the world with safety belts as standard equipment. Nine years later all cars had safety belts, inspired by Federal regulations.

We don't just settle for the legal minimum, either:

The law says all cars must have two brake circuits. Volvos have two *triangular* circuits, each controlling three wheels. So if one circuit fails, you still have about 80% of your braking power.

Volvos also have many safety features not required by law:

Like front and rear ends which absorb the impact of collisions. Four-wheel disc brakes with a pressure-proportioning valve to reduce the chances of rear-wheel lock-up. Child-proof rear doors. Rear window defrosters.

Now who would you rather buy a car from?

A company that builds a safe car because someone else made them do it?

Or a company that builds a safe car because their conscience made them do it?

VOLVO

1. February 13, 2025 Executive Order 14212, establishing the MAHA Commission. The Order identifies "electromagnetic radiation" as a subject of study in efforts to combat childhood chronic disease in the United States.[13]
2. Comments from the U.S. Secretary of Health, Robert F. Kennedy Jr., underscoring the need to remove cell phones from schools due to public health concerns.[14]
3. The publication of a 2025 World Health Organization-commissioned scientific review concluding high certainty that RF electromagnetic field ("EMF") exposure increases the incidence of cancer in experimental animals, with the certainty of evidence being strongest for malignant heart schwannomas and gliomas.[15]
4. A 2025 IEEE article by Dr. James C. Lin, former member of the International Commission on Non-Ionizing Radiation Protection ("ICNIRP") and one of the world's leading experts on the biological effects of RF radiation, argues that the WHO-EMF Project's reviews are methodologically flawed, narrowly focused on thermal effects, and shaped by conflicts of interest, all ultimately undermining the scientific integrity of global RF-EMF exposure guidelines.[16]
5. A 2023 IEEE "Health Matters" article, also by Dr. James C. Lin, stating: "This review discusses the assumptions underlying the standards and the outdated

[13] Exec. Order No. 14212, 90 Fed. Reg. 9833, § 4(a) (Feb. 19, 2025).
[14] U.S. Secretary of Health, Robert F. Kennedy Jr., has plans to collaborate with states to remove cell phones from schools. He notes that cell phones, when around children for extended periods of time, can cause neurological damage, cellular damage, and cancer. He also highlights the connection between cell phone use and "depression, poor performance in schools, suicidal ideation, and substance abuse." *See RFK Jr. launches investigation into 'high levels' of heavy metals in baby formula*, Fox & Friends (Mar. 20, 2025), https://www.foxnews.com/video/6370269070112.
[15] Meike Mevissen et al., *Effects of radiofrequency electromagnetic field exposure on cancer in laboratory animal studies, a systematic review*, 199 Env't Int'l 109482 (2025), https://doi.org/10.1016/j.envint.2025.109482.
[16] James C. Lin, *World Health Organization's EMF Project's Systemic Reviews on the Association Between RF Exposure and Health Effects Encounter Challenges [Health Matters]*, 26(1) IEEE Microwave Mag. (Jan. 2025), https://ieeexplore.ieee.org/document/10795296.

exposure metrics employed and concludes that the revised guidelines do not adequately protect children, workers, or the public from exposure to RF radiation or people with sensitivity to electromagnetic radiation from wireless devices and systems."[17]

6. A 2022 publication by the International Commission on the Biological Effects of Electromagnetic Fields[18] stating: "In this paper, we show how the past 25 years of extensive research on RFR demonstrates that the assumptions underlying the FCC's and ICNIRP's exposure limits are invalid and continue to present a public health harm."[19]
7. Freedom of Information Act ("FOIA") records and FCC-certified lab results that reveal non-compliance with the Commission's RF radiation exposure limits for both wireless devices and wireless telecommunications infrastructure.[20]

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[17] James C. Lin, *RF Health Safety Limits and Recommendations [Health Matters]*, IEEE Microwave Mag. 24(6) (June 2023), https://ieeexplore.ieee.org/document/10121536.

[18] The International Commission on the Biological Effects of Electromagnetic Fields ("ICB-EMF") was created in 2021 to issue guidelines for the public and workers from electric, magnetic and electromagnetic fields between 0 and 300 GHz based on peer-reviewed scientific research publications. The ICB-EMF is comprised of "a multidisciplinary consortium of scientists, doctors and related professionals who are, or have been, involved with research related to the biological and health effects of electromagnetic frequencies up to and including 300 GHz." *See* Int'l Comm'n on the Biological Effects of Electromagnetic Fields (ICBE-EMF), *Who we are*, https://icbe-emf.org/who-we-are/ (last visited July 18, 2025).

[19] Int'l Comm'n on the Biological Effects of Electromagnetic Fields (ICBE-EMF), *Scientific evidence invalidates health assumptions underlying the FCC and ICNIRP exposure limit determinations for radiofrequency radiation: implications for 5G*, 21 Env't Health 92 (2022), https://doi.org/10.1186/s12940-022-00900-9.

[20] *See* EHT, *Federal Communications Commission (FCC) Release of 11 Records to the Environmental Health Trust (EHT) in response to a Freedom of Information Act (FOIA*), Apr. 21, 2024, https://ehtrust.org/federal-communications-commission-fcc-release-of-11-records-to-the-environmental-health-trust-eht-in-response-to-a-freedom-of-information-act-foia-re-foia-control-nos-2023-000281-and-2023-0003/. *See also Press Release: Concealed FCC Cell Phone Radiation Tests Show Human 'Exposure Limits Were Exceeded'*, EHT, (Apr. 22, 2024), https://ehtrust.org/press-release-concealed-fcc-cell-phone-radiation-tests-show-human-exposure-limits-were-exceeded/. On FCC-certified lab results, *see* Plaintiff's Supplemental Filing Regarding Independent Testing of Plaintiff's Unlocked Cell Phones Supplementing Information Provided in Plaintiff's Reply Memorandum In Support of Plaintiff's Motion for a Finding of General Causation, or in the Alternative, Motion for Limited Discovery, Ex. 1, Block v. Nokia, No. 2015 CA 002114 B (D.C. Super. Ct. July 25, 2024), https://www.dropbox.com/scl/fi/cb3lmzewwmob10k2npxu7/Exhibit-1-to-Plaintiff-s-Supplemental-Filing-Regarding-Independent-Testing-of-Plaintiff-s-Unlocked-Cell-Phones-Supplementing-Information-Provided-in-Plaintiff-s-Reply-Memorandum.pdf?rlkey=hp2mf077w4iba1qofcyfo6zwh&st=riw8x44x&dl=0.

8. The New Hampshire 5G Commission,[21] established through bi-partisan legislation in 2019,[22] published its final report in November of 2020.[23] The report contains 15 recommendations intended "to bring about greater awareness of cell phone, wireless and 5G radiation health effects and to provide guidance to officials on steps and policies that can reduce public exposure."[24]
9. An analysis of the NIH National Toxicology Program ("NTP") RF radiation study which concluded that the Commission's RF radiation exposure limits should be reduced by at least 200 to 400 times to adequately protect children.[25]
10. A burgeoning state court record about alleged health harms resulting from wireless devices.[26]
11. Multidistrict litigation ("MDL") filed by 35 State Attorneys General against social media companies concerning addiction to their products.[27] Addiction to social

[21] To ensure that the findings of the New Hampshire 5G Commission would be credible, its membership was comprised of independent subject matter experts with backgrounds in physics, engineering electromagnetics, epidemiology, biostatistics, occupational health, toxicology, medicine, public health policy, business, and law. A telecommunications industry representative also served on the Commission.
[22] HB 522, Chapter 260, Laws of 2019, RSA 12-K:12–14, https://legiscan.com/NH/text/HB522/id/2030503.
[23] *Final Report of the Commission to Study The Environmental and Health Effects of Evolving 5G Technology*, State of New Hampshire (Nov. 1, 2020), https://gc.nh.gov/statstudcomm/committees/1474/reports/5G%20final%20report.pdf.

[24] Id. at 8.
[25] Uloma I. Uche & Olga V. Naidenko, *Development of health-based exposure limits for radiofrequency radiation from wireless devices using a benchmark dose approach*, 20 Env't Health 84 (2021), https://doi.org/10.1186/s12940-021-00768-1. On the NTP study, *see also* National Toxicology Program, *Cell Phone Radio Frequency Radiation*, ntp.niehs.gov, https://ntp.niehs.nih.gov/research/topics/cellphones (last visited May 30, 2025).
[26] Ongoing litigation involves a plaintiff who is suing multiple cell phone manufacturers and wireless telecommunications infrastructure operators, alleging that she suffered an intracerebral hemorrhage (stroke) because of her cell phone use. *See* Block v. Nokia, No. 2015 CA 002114 B (D.C. Super. Ct. filed Mar. 26, 2015).
[27] As of July 11, 2025, over 1,867 civil cases are consolidated under the MDL. *People of the State of California v. Meta Platforms, Inc.,* No. 4:23-cv-05448 (N.D. Cal., filed Oct. 24, 2023); *In re: Social Media Adolescent Addiction/Personal Injury Products Liability Litigation*, MDL No. 3047 (N.D. Cal., filed Oct. 24, 2023); *see also Social Media Harm Lawsuit*, Motley Rice LLC, https://www.motleyrice.com/social-media-lawsuits (last visited July 11, 2025).

media is fueling increased daily use of wireless devices which increases users' duration and proximity to RF radiation exposure emitted by such wireless devices.

12. The United States Supreme Court ruling in Loper Bright Enterprises v. Raimondo, which eliminated the doctrine of *Chevron* deference—now enabling courts to utilize their independent judgement as to whether agencies acted within their statutory authority.[28]

ARGUMENT

I. Petition to Implement D.C. Circuit Judgment and Mandate and Reopen Notice of Inquiry.

The D.C. Circuit opinion and judgment in EHT v. FCC was issued on August 13, 2021.[29] The D.C. Circuit's mandate was issued to the FCC on October 5, 2021.[30] The judgment states as follows: "We grant the petitions in part and remand to the Commission. The Commission failed to provide a reasoned explanation for its determination that its guidelines adequately protect against harmful effects of exposure to radiofrequency radiation unrelated to cancer."[31] The judgment further directs the Commission to provide reasoned explanations for its decision to maintain its 1996 radiofrequency ("RF") radiation human exposure regulations in six areas, as follows:

[28] "*Held*: The Administrative Procedure Act requires courts to exercise their independent judgment in deciding whether an agency has acted within its statutory authority, and courts may not defer to an agency interpretation of the law simply because a statute is ambiguous; *Chevron* is overruled." Loper Bright Enterprises v. Raimondo, 603 U.S. 369 (2024).
[29] EHT v. FCC, 9 F.4th.
[30] EHT v. FCC, No. 20-1025, Doc. No. 1916917 (D.C. Cir. Oct. 2, 2021).
[31] EHT v. FCC, 9 F.4th at 900.

i. "Provide a reasoned explanation for its decision to retain its testing procedures for determining whether cell phones and other portable electronic devices comply with its guidelines,"

ii. "Address the impacts of RF radiation on children,"

iii. Address the "health implications of long-term exposure to RF radiation,"

iv. Address the "ubiquity of wireless devices,"

v. Address the "other technological developments that have occurred since the Commission last updated its guidelines," and

vi. "Address the impacts of RF radiation on the environment."[32]

This Petition outlines proposed actions for the Commission to take in these key areas to comply with the Court's remand.

EHT filed a "Request to Reopen and Refresh Record" with the Commission on November 30, 2021.[33] The contents of this "Request" are incorporated by reference as if restated herein. Pertinent to our "Request," the Commission cannot fulfill the Court's remand without initiating a "new agency action"[34] that includes soliciting input from relevant federal agencies and the public. This input must specifically address matters not acknowledged in the final order terminating the *2013 Notice of Inquiry*.

Co-plaintiff in EHT v. FCC, Children's Health Defense ("CHD"), filed a *Petition To Implement D.C. Circuit Judgment And Mandate, Reopen Notice Of Inquiry And Perform Tasks Ordered By The Court, Petition To Implement CEQ-NEPA Procedures Update And Request For*

[32] EHT v. FCC, 9 F.4th at 914.
[33] EHT, Submission in ET Docket No. 03-137, ET Docket No. 13-84 (Nov. 30, 2021) (filed with the FCC, ECFS No. 11302824721650), https://www.fcc.gov/ecfs/search/search-filings/filing/11302824721650.
[34] Id. at 5.

Prompt Ruling on April 4, 2023.[35] In its filing, CHD stated its concurrence and adoption of EHT's *Request to Reopen and Refresh Record* filed on November 30, 2021.[36]

The D.C. Circuit Court of Appeals reviewed the available record and rejected much of the Commission's December 4, 2019 Order[37] ("*2019 Order*") terminating the Docket 13-84 *Notice of Inquiry* opened "to determine whether there is a need for reassessment of the Commission radiofrequency exposure limits and policies."[38] Most significantly, the Court held that the Commission's *2019 Order* "failed to provide reasoned decision-making and was arbitrary and capricious with respect to its determination that the existing guidelines for human RFR emissions and exposures adequately protect against harmful effects of exposure to RF radiation unrelated to cancer."[39] In addition to the aforementioned six (6) elements that the Court ruled the Commission must provide,[40] the Court also stated:

> That failure undermines the Commission's conclusions regarding the adequacy of its testing procedures, particularly as they relate to children, and its conclusions regarding the implications of long-term exposure to RF radiation, exposure to RF pulse or modulation, and the implications of technological developments that have occurred since 1996, all of which depend on the premise that exposure to RF radiation at levels below its current limits causes no negative health effects. Accordingly, we find those conclusions arbitrary and capricious as well. Finally, we find the Commission's order arbitrary and capricious in its complete failure to respond to comments concerning environmental harm caused by RF radiation.[41]

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[35] Petition of Children's Health Defense, *Petition To Implement D.C. Circuit Judgment And Mandate, Reopen Notice Of Inquiry And Perform Tasks Ordered By The Court, Petition To Implement CEQ-Mandated NEPA Procedures Update And Request For Prompt Ruling*, Targeted Changes to the Commission's Rules Regarding Human Exposure to Radiofrequency Electromagnetic Fields, ET Docket No. 19-226, (Apr. 4, 2023).
[36] Id. at 2.
[37] *Reassessment of Federal Communications Commission Radiofrequency Exposure Limits and Policies*, Resolution of Notice of Inquiry, ET Docket 13-84, FCC 19-126, ¶¶ 10-16 (2019).
[38] *Reassessment of Federal Communications Commission Radiofrequency Exposure Limits and Policies,* Notice of Inquiry, ET Docket 13-84, ¶¶ 5-9, 205-252 (2013).
[39] EHT v. FCC, 9 F.4th at 900.
[40] EHT v. FCC, 9 F.4th at 914.
[41] Id. at 903.

The Commission has failed to comply with the Court's mandate within a reasonable period. It could do so by notifying the Court that, upon reconsideration of the record, a) it is not possible to provide a reasoned explanation for not updating its RF radiation exposure guidelines given the overwhelming body of scientific evidence in support of revised guidelines and b) the Commission is therefore proceeding to rulemaking in each of the six subject matter areas identified by the Court.

If the Commission chooses not to proceed directly to rulemaking, this petition lays out suggested approaches for complying with the Court mandate. The areas where the Court directed the Commission to provide a reasoned explanation for its deficient acts or omissions regarding the Commission's RF radiation guidelines are set out below. For each deficiency area, this Petition provides: a) general background information, b) a description of significant record deficiencies with updated post-opinion scientific studies and evidence, c) suggested approaches to comply with the Court mandate, and d) additional recommended measures the Commission should undertake to fulfill its congressionally-mandated obligation to set RF radiation exposure limits that adequately protect human health and the environment.

By its own admission, the Commission states in its *2013 Notice of Inquiry* that it is "not a health and safety agency" and that it must "defer to other organizations and agencies with respect to interpreting the biological research necessary to determine what levels are safe."[42] In Cellular Phone Taskforce v. FCC,[43] the Court refused to disturb the Commission's RF radiation exposure regulations in large part because it ruled that the Commission could rely upon other federal

[42] *Reassessment of Federal Communications Commission Radiofrequency Exposure Limits and Policies,* Notice of Inquiry, ET Docket 13-84, ¶¶ 5-9, 205-252 (2013) https://docs.fcc.gov/public/attachments/FCC-13-39A1.pdf.
[43] Cellular Phone Taskforce v. FCC, 205 F.3d 82 (2d Cir. 2000).

agencies—such as the EPA—for guidance on setting truly protective RF radiation exposure limits:

> ...it was not arbitrary and capricious for the FCC to conclude that it need not supply the new evidence to the other federal agencies with expertise in the area. **[The FCC] could reasonably expect those agencies to keep abreast of scientific developments in carrying out their missions.** For instance, the EPA had participated not only in the hearings and comments leading to the promulgation of the Guidelines, but also had been on the verge of releasing its own draft guidelines pertaining to the health effects of RF radiation in 1996. It was fully reasonable for the FCC to expect the agency with primacy in evaluating environmental impacts to monitor all relevant scientific input into the FCC's reconsideration, particularly because the EPA had been assigned the lead role in RF radiation health effects since 1970. See 42 U.S.C. § 2021(h). (Emphasis added.)[44]

However, the Cellular Phone Taskforce opinion did not account for the fact that, today, no federal agency or agencies with health or environmental expertise is keeping "abreast of scientific developments" regarding the biological effects of RF radiation. While the EPA was formerly tasked with, and was poised to issue, RF radiation limits that consider both the thermal and non-thermal biological impacts of RF radiation,[45] its research on EMFs and the development of RF radiation standards was abruptly halted just before the passage of the Telecommunications Act of 1996.[46] In April of 1993, prior to the termination of EPA's work on EMFs, the EPA

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[44] Id. at 91.

[45] In 1995, the EPA had briefed both the FCC and the National Telecommunications and Information Administration regarding its two Phases of activities related to the development of RF radiation exposure safety standards. Phase 1 was intended to address only short-term thermal impacts of RF radiation. Phase 2 was intended to address modulated and non-thermal exposures to RF radiation and result in the final guidelines. *See* Memorandum from Robert F. Cleveland, Off. of Engineering and Tech. to FCC Secretary, Ex Parte Presentation by U.S. EPA (Mar. 22, 1995) https://ehtrust.org/wp-content/uploads/Memorandum-from-Robert-F.-Cleveland-Office-of-Engineering-and-Technology-to-FCC-Secretary-Ex-Parte-Presentation-by-U.S.-Environmental-Protection-Agency-March-22-1995-.pdf. Three months later, the EPA informed the FCC that its final RF radiation guidelines "are substantially complete and beginning to enter the review phase which would include a 30-day pre-publication review by the RF Interagency Work Group, a 60-day review by selected stakeholders, and a final, 90-day review by the Office of Management and Budget. *See* Letter from E. Ramona Trovata, EPA, Dir., Off. of Radiation and Indoor Air, to Richard M. Smith, Chief, FCC, Off. of Eng'g and Tech. (June 19,1995) https://ehtrust.org/wp-content/uploads/Letter-from-E.-Ramona-Trovata-EPA-Office-of-Radiation-and-Indoor-Air-to-Richard-M.-Smith-Chief-FCC-Office-of-Engineering-and-Technology-June-19-1995-.pdf.

[46] As *Microwave News* reported in its September/October 1995 issue, "The Senate Committee on Appropriations has cut $350,000 from the Environmental Protection Agency's (EPA) EMF budget because "**[t]he committee believes**

submitted comments to FCC Docket No. 93-62 titled, "Guidelines for Evaluating the Environmental Effects of Effects of Radiofrequency Radiation (Clas No. 920662)." In its comment, the EPA wrote: "The rationale provided in ANSI/IEEE to explain fundamental characteristics of the 1992 ANSI/IEEE guidelines, in many cases, lacks explanation, consistency, and well-founded justifications."[47] The EPA concluded by urging the FCC *not* to adopt the 1992 ANSI/IEEE standard, and that the Commission request "an updated, comprehensive review of the biological effects on RF radiation."[48] On July 8, 2020, Lee Veal, the former Director of EPA's Radiation Protection Division, stated the following in an email to EHT's former Executive Director, Theodora Scarato: "The EPA does not currently have a funded mandate for radiofrequency matters… EPA's last review was in the 1984 document Biological Effects of Radiofrequency Radiation (EPA 600/8-83-026F)."

The federal government's longstanding failure to address the well-documented biological effects of RF radiation has effectively silenced critical agencies—such as the EPA, Occupational Safety and Health Administration ("OSHA"), the National Cancer Institute ("NCI"), and the CDC—depriving the Commission's 2013 *Notice of Inquiry* of essential input. These agencies

EPA should not engage in EMF activities." (Emphasis added.) In a September 13, 1995 report (No. 104-140), the Committee also stated: "Section 2118 of the Energy Policy Act of 1992 established a federal program to investigate and report on human health effects from [EMFs]. Congress mandated that this program of research and public communication be managed jointly by the Department of Health and Human Services and the [DOE]. No programmatic role was assigned to EPA, yet EPA has pursued a number of unintegrated activities on EMF that are of questionable value. Therefore, the Committee believes EPA should not engage in EMF activities." The House Appropriations Committee announced plans to cut EPA's "low-priority radiation programs," from the agency's 1996 fiscal year budget ($11,876,000). According to Dennis O'Connor, former EMF team leader at EPA headquarters in Washington D.C., the cut would eliminate EPA's EMF and RF/MW programs which involved criteria, standards, guidelines, program implementation, and environmental assessments. *See EPA's EMR Programs Face Budget Ax*, XV(4) Microwave News, July/Aug. 1995 at 4, https://www.yumpu.com/en/document/read/19047596/mwn-j-a95-microwave-news.

[47] Letter from Margo T. Oge, Dir., EPA Off. of Radiation and Indoor Air, to Thomas P. Stanley, Chief Eng'r, FCC Off. of Eng'g, Nov. 1993. Available at: https://ehtrust.org/wp-content/uploads/Epa-Letter-to-the-FCC-nov_93.pdf.

[48] Id. at 3.

have been unable to provide meaningful insights because they have not engaged in recent evaluations of the adequacy of the FCC's current human RF radiation exposure limits.[49]

The FDA's sole literature review of the biological effects of RF radiation exposure, published in February of 2020, is extremely narrow in scope, contains flagrant misrepresentations of the scientific literature, and addresses studies performed only through

[49] The CDC has no scientific reports, research reviews, or scientific evaluations regarding RF radiation safety issues, nor does the agency employ staff with expertise in interpreting the latest science on RF radiation and/or on evaluating risk. Notably, FOIA requests submitted by EHT to the CDC revealed that Kenneth Foster, a telecommunications industry consultant, assisted in drafting several CDC webpages on the health effects of RF radiation. Allowing an individual with such clear conflicts of interest to influence public health messaging not only undermines scientific integrity but also raises serious concerns about regulatory capture and the erosion of impartial, evidence-based policymaking.

As for OSHA, in the mid-1990s the agency developed elements of a "Comprehensive RF Protection Program." *See Elements of a Comprehensive RF Protection Program: Role of RF Measurements*, Occupational Safety & Health Admin. (Apr. 30, 1999), https://www.osha.gov/radiofrequency-and-microwave-radiation/role-of-rf-measurements. However, this Program was never implemented. On July 1, 2015, OSHA issued the following response to the FCC following the FCC's request for comments regarding its 2013 *Notice of Inquiry*: "RF emissions are not on OSHA's active regulatory agenda, so we have not conducted a comprehensive literature review or risk assessment on RF hazards." *See* Letter from William Perry, Dir., Directorate of Standards and Guidance, Occupational Safety & Health Admin., to Julius Knapp, Chief, Off. of Eng'g & Tech., FCC (July 1, 2015), https://ehtrust.org/wp-content/uploads/July-1-2015-Letter-from-the-Department-of-Labor-to-the-FCC-1-1.pdf.

Additionally, OSHA acknowledges that it "does not appear to have a particularized program in place to ensure worker safety with regard to RF exposure from the wide variety of RF transmitters regulated by the Commission." The agency states: "…we are not aware that OSHA has adequate resources to ensure compliance with our limits for occupational/controlled exposure among our licensees and grantees." *Reassessment of Federal Communications Commission Radiofrequency Exposure Limits and Policies,* Notice of Inquiry, ET Docket No. 13-84, ¶ 78 (2013), https://docs.fcc.gov/public/attachments/FCC-13-39A1.pdf.

The NCI has not evaluated the safety of cell tower radiation and 5G. When directly asked about its activities regarding research on FCC limits for cell phone radiation, NCI responded: "Neither the literature reviews, nor the fact sheets [referring to NCI's webpages], make safety determinations." *See* Email from NCI Agent to Mary Anne Bright, RN (Jan. 4, 2015), https://ehtrust.org/wp-content/uploads/NationalCancerInsituteResponsetoMCPSparentInquiryaboutMontgomeryCountySchoolsStatement.pdf at 1 (last visited July 17, 2025). The NCI also states: "As a Federal research agency, the NCI is not involved in the regulation of radiofrequency telecommunications infrastructure and devices, nor do we make recommendations for policies related to this technology…Our sister agencies, the FDA as well as the FCC, retain responsibility for reviewing guidance on safety concerns and informing the public if those circumstances change." Letter from the Nat'l Cancer Inst. to Denise Ricciardi, Member, New Hampshire State Comm'n on 5G (July 30, 2020), https://ehtrust.org/wp-content/uploads/NH-5G-Comission-Correspondence-from-Federal-Agencies-.pdf at 30, 34. Because it had conducted no relevant research, the only contribution the NCI could make to the FCC's *2013 Notice of Inquiry* on RF radiation exposure was signing a one-paragraph letter. *See* Martha S. Linet et al., *Comment on ET Docket No. 13-84*, Reassessment of Federal Communications Commission Radiofrequency Exposure Limits and Policies, ET Docket No. 13-84 (2013), https://ehtrust.org/wp-content/uploads/May-13-2014-Comment-on-FCC-ET-Docket-No.-13-84-by-the-National-Cancer-Institute-and-National-Institute-of-Environmental-Health.pdf.

2018. [50] These significant shortcomings and deficiencies were highlighted in a 2020 report issued by the U.S. Government Accountability Office ("GAO") which states: "The assessment focused on cancer-related animal and human studies of frequencies below 6 GHz. The assessment did not include non-cancer outcomes or the biological effects of frequencies above 6 GHz."[51] Further, a limited literature review is not a substitute for a robust hazard and risk analysis of the broad range of RF radiation human health impacts evidenced by the peer-reviewed, published scientific literature. Because the Commission has no medical, health, or safety expertise regarding the biological effects of RF radiation exposure, it must urge Congress to allocate funds and resources to the appropriate federal agencies so they may evaluate the adequacy of the Commission's 1996 limits based on best practice methodology for safety assessment and standards development. [52]

The FDA and FCC continue to portray prominently their direct role in ensuring the public health is protected from RF devices, yet no action has been taken on the Court's mandate. For example, the FDA's website showed images of woman operating a cell phone pressed next to her head and the side of her face (*See* Figure 1). To this day, the FDA keeps this image, which contravenes its own recommendations on its radiation safety page for reducing radiation exposure.[53]

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[50] The FDA's 2020 literature review of the biological effects of RF radiation exposure focuses only on cell phone RF radiation emissions, not RF radiation generated by wireless telecommunications infrastructure or other RF radiation-emitting technologies like Wi-Fi access points. Further, the review solely addresses cancer, failing to acknowledge scientifically-documented impacts to reproduction, brain development, memory, DNA damage, and other adverse RF radiation health effects. *See* EHT, *FDA's Misrepresentations of the FDA's Scientific Research Review and Safety Determinations Regarding Cell Phone and Wireless Radiation Safety*, https://ehtrust.org/wp-content/uploads/EHT-Critique-of-FDA-Activites-on-Cell-Phone-Radiation-Health-Effects-2023.pdf, (last visited May 30, 2025).

[51] U.S. Gov't Accountability Off., GAO-21-265P, 5*G Wireless: Capabilities and Challenges for an Evolving Network*, (Nov. 2020) at 44.

[52] *See* Attachment 1 for best practice recommendations regarding systematic reviews on human health risks posed by environmental exposures.

[53] *Scientific Evidence for Cell Phone Safety*, Food and Drug Administration, https://www.fda.gov/radiation-emitting-products/cell-phones/scientific-evidence-cell-phone-safety (last visited Aug. 6, 2025) (current as of June 30, 2025).



Figure 1. FDA website shows a woman operating a cell phone by pressing it to her head, contrary to FCC, FDA, and industry guidance for reducing exposure to harmful radiation.[54]

Both the FDA and FCC post cell phone radiation reduction recommendations that reference keeping the phone away from the body and on speakerphone. The FDA website page titled "Scientific Evidence for Cell Phone Safety," which features in Figure 1, links to a page providing cell phone radiation reduction guidance such as, "Use speaker mode, head phones, or ear buds to place more distance between your head and the cell phone."[55] Further, some of the FCC's cell phone radiation reduction recommendations on their website state:

> Some measures to reduce your RF exposure include:
>
> - Reduce the amount of time spent using your wireless device.
> - Use a speakerphone, earpiece or headset to reduce proximity to the head (and thus head exposure). While wired earpieces may conduct some energy to the head and wireless earpieces also emit a small amount of RF energy, both wired and wireless earpieces remove the greatest source of RF energy (the cell phone or handheld device) from proximity to the head and thus can greatly reduce total exposure to the head.

[54] Id.
[55] *Reducing Radio Frequency Exposure from Cell Phones*, Food and Drug Administration, https://www.fda.gov/radiation-emitting-products/cell-phones/reducing-radio-frequency-exposure-cell-phones, (last visited July 15, 2025).

- Increase the distance between wireless devices and your body.[56]

FCC-required notices are embedded in all cell phones. For example, the iPhone 16 Pro and other models' radiation exposure language can be found by going to "Settings," then "General," then "Legal and Regulatory," then "RF Exposure." It states, in part: "iPhone is evaluated in positions that simulate uses against the head, with no separation, and when worn or carried against the torso of the body, with 5mm separation." (*See* Figure 2). Note that they claim it is evaluated for uses against the head with no separation. Yet, at 2 mm separation limits were exceeded for some cell phones the FCC tested, per the FOIA revelations. Relatedly, new evidence shows that this is not an isolated incident, as additional FCC-certified lab studies showed limits being exceeded on other cell phones, including at 5 mm separation.[57]

[56] *Wireless Devices and Health Concerns*, Federal Communications Commission, https://www.fcc.gov/consumers/guides/wireless-devices-and-health-concerns (last visited July 15, 2025).
[57] Plaintiff's Supplemental Filing, Ex. 1, Block v. Nokia, No. 2015 CA 002114 B, *supra* note 20.

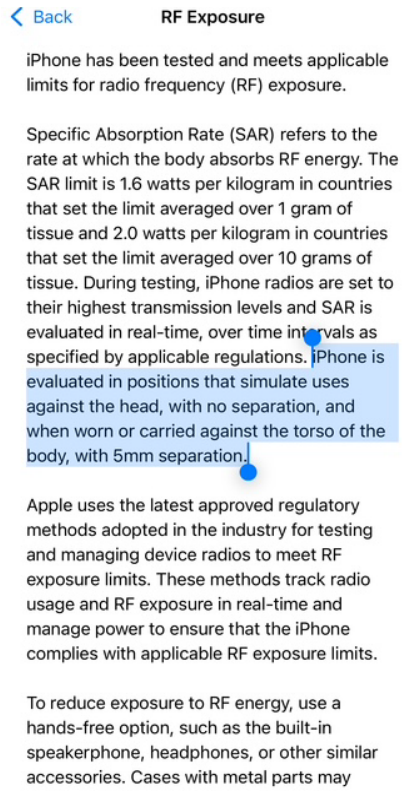


Figure 2. Partial screenshot of the iPhone 16 Pro radiation exposure notice, explaining that the iPhone is tested at 5 mm from the body, yet common usage by the public has cell phones routinely pressed against the skin for long durations.

The guidelines also state:

> To reduce exposure to RF energy, use a hands-free option, such as the built-in speakerphone, headphones, or other similar accessories. Cases with metal parts may change the RF performance of the device, including its compliance with RF exposure guidelines, in a manner that has not been tested or certified. [*See* Figure 3].

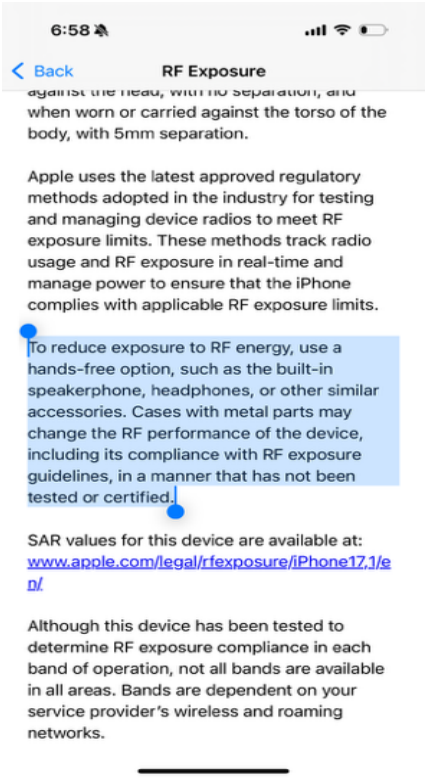


Figure 3. Partial screenshot of the iPhone 16 Pro radiation exposure notice, offering safety recommendations for reducing RF exposure. It is concerning and emblematic of this entire proceeding that the FDA website at Figure 1 prominently features a person pressing a phone to her head, and thus *not* following these radiation exposure reduction recommendations.

Additionally, the antennas on cell phones are located in various areas. Depending on how the cell phone is held near the body or the head it is quite possible for one or more of the antenna locations to be closer than 5mm or 2mm from the body, if not directly against the skin (i.e., 0mm from the body). For example, see Figures 4 and 5 below for some of the Apple iPhone 13 Pro Max antenna locations.



Figure 4. Exterior cut-out for iPhone 13 antenna.[58] The FCC nor the FDA feature information informing the public where antennas exist on their cell phones, nor recommend that the public avoid pointing those antennas at their eyes or skin.



Figure 5. iPhone 13 Pro Max antenna.[59]

The urgency for the FCC to engage relevant federal agencies and to act on the remand is further amplified by the fact that other developed countries, including China and Russia, have adopted RF radiation exposure limits that are drastically lower than those of the United States (see Figure 6). Indeed, as proven in other countries, robust cellular communication can be

[58] Hemant Kumar Vishwakarma & Achit Razdan, *Apple iPhone 13 Pro Max Teardown Report*, UnitedLex, https://unitedlex.com/insights/apple-iphone-13-pro-max-teardown-report/ (last visited July 15, 2025).
[59] Id.

accomplished at much lower effective radiated power levels, and thus lower radiation exposure levels.

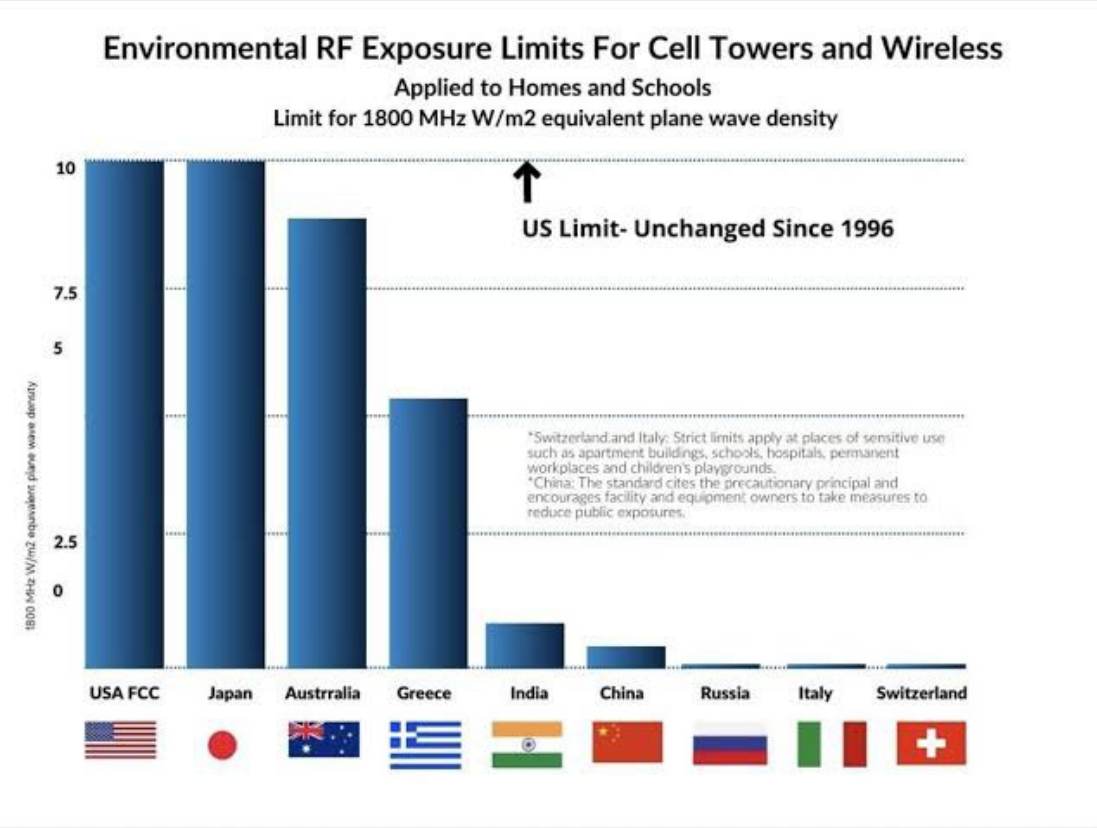


Figure 6. U.S. RF radiation exposure limits are higher than RF radiation exposure limits in China, Russia, Italy, and Switzerland by a factor of *10 times or more*.[60] Notably, many of these countries did not effectively defund their health care and environmental agencies' efforts into rigorously studying radiation impacts, unlike the effective defunding of the EPA. Note, that as of this year (2025), India has significantly relaxed its RF radiation exposure limit for 5G base towers.[61]

[60] EHT, Presentation to NTIA Off. of Spectrum Mgmt., *Recommendations to the NTIA Modernizing United States Spectrum Policy and Establishing a National Spectrum Strategy*, Dec. 12, 2023. https://www.ntia.gov/sites/default/files/environmental-health-trust-appendix-written-input.pdf. *See also* Ting Wu et al., *Safe for Generations to Come*, 16(2) IEEE Microwave Mag. 65 (2015), https://pmc.ncbi.nlm.nih.gov/articles/PMC4629874/ at Table 1, for a table of several countries' RF exposure limits, also viewable in Attachment 26.

[61] Kiran Rathee, *In relief to telcos, 5G radiation rules eased*, The Economic Times (Jan. 2, 2025), https://economictimes.indiatimes.com/industry/telecom/telecom-news/in-relief-to-telcos-5g-radiation-rules-eased/articleshow/116892570.cms.

1. Inadequacy of the FCC's RF Radiation Testing Procedures and Exposure Metrics Must Be Remedied.

a. Background.

The Court has directed the Commission to provide a reasoned explanation for its decision to retain its decades-old RF radiation testing procedures. The Court also instructed the Commission to consider whether RF radiation exposures below current limits (at non-heating levels) do not cause negative health effects unrelated to cancer.

Numerous serious issues have been raised about the Commission's compliance testing methodologies, including, but not limited to the following:

i. Premarket cell phone testing procedures solely address adverse health effects due to thermal (heating) level exposures, not biological effects. The wireless device test metric used, SAR, is a measure of the rate of RF energy absorption into body tissue. A higher SAR is thought to elevate tissue temperature, and thus, SAR is an inherently heat-based test.[62] The Commission's limits were established as a result of a behavioral study conducted in the 1980s during which five monkeys and eight rats were exposed to RF radiation for a duration of 40-minutes and 60-minutes.[63, 64] The SAR level at which point the animals stopped pressing their food lever and their internal temperature increased was the point at which the engineers determined "adverse effect." The limit was then set at 4 W/kg, to which the engineers applied arbitrary safety factors (discussed later in this section).

ii. The SAR testing approach assumes that the user's tissue can tolerate heating effects caused by the device, at least up to a limit, and that the only possible harm induced by RF radiation exposure is excessive heating. Importantly, SAR does not consider the total dose of RF radiation a person receives over time. In other words, so long as the rate of RF radiation absorption (the SAR level) remains below the Commission's RF radiation limit, the allowed hours of exposure can be infinite. Given the ubiquity of wireless technologies today, humans, flora, and fauna are clearly exposed to RF radiation far beyond a one-time, 40- to 60-minute exposure period. Thus, the foundation of the FCC's SAR limit is fundamentally flawed.

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[62] Dimitris J. Panagopoulos et al., *Evaluation of Specific Absorption Rate as a Dosimetric Quantity for Electromagnetic Fields Bioeffects*, 8(6) PLOS ONE e62663 (2013), https://doi.org/10.1371/journal.pone.0062663.
[63] J.O. de Lorge & C.S. Ezell, *Observing-responses of rats exposed to 1.28- and 5.62 GHz microwaves*, 1(2) Biolelectromagnetics 183 (1980), https://onlinelibrary.wiley.com/doi/10.1002/bem.2250010208.
[64] J.O de Lorge, *Operant behavior and colonic temperature of Macaca mulatta exposed to radio frequency fields at and above resonant frequencies* 5(2) Biolectromagnetics 233 (1984), https://onlinelibrary.wiley.com/doi/10.1002/bem.2250050211.

iii. SAR testing relies on a deeply flawed model—a homogeneous, liquid filled mannequin called a Specific Anthropomorphic Mannequin ("SAM"). SAM is designed to represent a large adult male, and thus, fails to account for the unique vulnerabilities of infants and children whose smaller heads, thinner skulls, and higher dielectric properties of tissues make them more susceptible to the biological harms of RF radiation exposure compared to adults.[65] The model also fails to reflect the actual and varying tissue densities and electrical conductivities present in the human body.[66]

iv. The Commission's RF radiation compliance SAR test uses time and volume averaging, both of which mask the erratic high peaks of exposure and RF hotspots into specific bodily tissues that can occur from magnification, pulsation, and/or modulation of an RF radiation signal.[67] Thus, this testing methodology fails to capture the public's real-world RF radiation exposures from wireless devices and wireless telecommunications facilities.

v. Cell phones are not required to be tested at 0 mm from the body, despite the fact that phones are typically used in body contact positions (e.g., held up to the ear, held pressed against the head, and stored in clothing pockets or bras, and rested or held directly against the body). Per the Commission's own laboratory tests, several phone models exceeded SAR limits when tested at 2 mm from the body,[68] yet the same

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[65] The International Agency for Research on Cancer's 2013 Monograph report states: "In children using mobile phones, the average deposition of RF energy may be two times higher in the brain and up to ten times higher in the bone marrow of the skull than in adult users." *See* IARC Working Grp. on the Evaluation of Carcinogenic Risks to Humans, *Non-Ionizing Radiation, Part 2: Radiofrequency Electromagnetic Fields* 34 (2013), https://publications.iarc.fr/Book-And-Report-Series/Iarc-Monographs-On-The-Identification-Of-Carcinogenic-Hazards-To-Humans/Non-ionizing-Radiation-Part-2-Radiofrequency-Electromagnetic-Fields-2013. *See also* Om P. Gandhi, *supra* note 10; C. Fernández, et al., *Absorption of wireless radiation in the child versus adult brain and eye from cell phone conversation or virtual reality*, J. Env't Rsch., Vol. 167, 694-699 (2018), https://www.sciencedirect.com/science/article/abs/pii/S0013935118302561.

[66] *See generally* Devra Davis, *Disconnect: A Scientist's Solution for Safer Technology* (2024).

[67] David H. Gultekin & Lothar Moeller, *NMR imaging of cell phone radiation absorption in brain tissue*, 110(1) Proc. Nat'l Acad. Scis. U.S.A. 58 (2013), https://doi.org/10.1073/pnas.1205598109. *See also* Claudio E. Fernández-Rodríguez et al., *Dosimetric Simulations of Brain Absorption of Mobile Phone Radiation–The Relationship Between psSAR and Age*, 3 IEEE Access 2425 (2015), https://doi.org/10.1109/ACCESS.2015.2502900. *See also* FCC, OET Bull. No. 65, *Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields* (1997), https://transition.fcc.gov/oet/info/documents/bulletins/oet65/oet65.pdf at 5.

[68] On January 3, 2023 and February 8, 2023, Theodora Scarato, former Executive Director of EHT, requested records related to cell phone radiation tests performed by the Commission between January of 2017 through April of 2020. On September 29, 2023, Ms. Scarato received 11 of 18 documents in response to her request. (The Commission argued that the seven documents withheld from production were protected under Exemption 5 of the FOIA. EHT submitted a letter to the FCC's Office of General Counsel appealing the FCC's decision to withhold documents on December 28, 2023).

The FOIA records reveal that the FCC tested several popular cell phones manufactured by Apple, Samsung, Motorola, and BLU at 2 mm from the body (simulating real-world use such as carrying a phone in a pocket). *See Environmental Health Trust FOIA Project*, EHT, https://ehtrust.org/environmental-health-trust-foia-project/ (last visited July 15, 2025). *See also* Letter from Theodora Scarato, Exec. Dir., EHT, to Off. of Gen. Couns., FCC (Dec. 28, 2023), https://ehtrust.org/wp-content/uploads/EHT-Scarato-Appeal-RE_-FOIA-Control-Nos.-2023-000281-and-2023-000325_-FCC-2-mm-Cell-Phone-Radiation-SAR-Tests-December-28-2023-.docx.pdf. The FCC's testing was conducted in response to an August 21, 2019 *Chicago Tribune* investigation which found that cell phones, like the Apple iPhone 7, tested in close body contact (at 2 mm and 5 mm), exceed the FCC's RF radiation emissions limit.

phones were compliant when tested at a separation distance ranging from 5 mm to 15 mm from the body, depending on the model.

b. Description of Significant Record Deficiencies and Updated Post-Decision Evidence.

Despite a massive record containing extensive, evidence-based critiques, the Commission chose to maintain its heat-based SAR testing method for evaluating wireless device safety. The Commission's *2019 Order* ignores scientific findings that RF radiation emissions, with complex pulsation and modulation, can cause biological effects unrelated to cancer at levels well below current RF radiation exposure limits. In its *2019 Order* the Commission also failed to address serious concerns about the adequacy of the SAM model and its reliance on outdated standardized testing positions that do not accurately reflect real-world use of wireless devices, and thus, real-world RF radiation exposures to bodily tissues.

c. Recommended Approaches to Comply with the Remand and Address the Subject Impacts.

To demonstrate it has provided a reasoned explanation for its decision to retain its RF radiation testing procedures for cell phones and portable electronic devices, the Commission should do the following:

1. Address the Adequacy of Heat-Based RF Radiation Limits. Because current compliance tests for RF radiation-emitting devices rely exclusively on the SAR metric—which measures only acute, thermal (heating) effects—the Commission

See Sam Roe, *We Tested Popular Cellphones for Radiofrequency Radiation. Now the FCC Is Investigating*, Chic. Trib. (Aug. 23, 2019), https://www.chicagotribune.com/2019/08/21/we-tested-popular-cellphones-for-radiofrequency-radiation-now-the-fcc-is-investigating.

The FCC's own testing reveals that various cell phone models exceed the FCC's current RF radiation emissions limit when tested at real-world distances (2 mm from the body). For example, the Samsung Galaxy J emits 5.2W/kg at that distance – this is 300% higher than the FCC's 1.6W/kg limit. *See* SAR test findings of the 2 mm tests at *FCC cell phone radiation tests – FOIA*, EHT, https://ehtrust.org/wp-content/uploads/FCC-cell-phone-radiation-tests-foia-.jpg (last visited July 18, 2025).

must evaluate and respond to evidence of non-thermal biological effects unrelated to cancer. The Commission must also engage relevant federal agencies to review the record and post-opinion scientific data to ensure that the totality of the science regarding the non-thermal health effects of RF radiation is properly examined.

2. Develop Updated Metrics and Testing Procedures for Both Pre-Market and Post-Market RF Radiation Compliance. The heat-based SAR limit currently serves as the foundation for 1) pre-market compliance testing of RF radiation-emitting devices and 2) the Commission's Maximum Permissible Exposure ("MPE") RF radiation limits used for evaluating ambient environmental RF radiation exposures (such as those generated by cell towers). When the Commission first established RF radiation limits in its *1996 Report and Order*, it clarified that its MPEs were based on a SAR limit of 4 W/kg.[69] Thus, all of the Commission's RF radiation limits are derived from the 4 W/kg SAR threshold which fails to account for the scientifically-documented, non-thermal biological effects linked to RF radiation exposure. As such, the Commission should adopt updated RF radiation metrics and testing procedures to ensure protection against:

    i. Non-cancerous biological effects from RF radiation exposures unrelated to heat;

    ii. Long-term and chronic RF radiation exposures;

    iii. Modulated RF radiation exposures and pulsed RF radiation exposures;

    iv. The unique biological vulnerabilities of sensitive populations to RF radiation including, but not limited to the developing fetus, infants, children, people with implanted medical devices, and the elderly; and
    v. Environmental harm (flora and fauna), with consideration for the potential larger disruption of delicate ecological webs (e.g., reduced agricultural output due to the adverse impacts of RF radiation on bee colony health).[70]

3. Provide a Reasoned, Evidence-Based Explanation for the SAR Level at Which the Commission Says Adverse Thermal Effects from RF Radiation Occur. If the Commission continues to incorrectly assert that behavioral disruption to animals from overheating is the only adverse effect caused by RF radiation exposure—and that SAR remains an appropriate metric with 4 W/kg as the threshold for harm—then it must also address the record evidence demonstrating:

[69] *Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation*, 61 FR 41006 (1996), https://docs.fcc.gov/public/attachments/FCC-96-326A1.pdf.
[70] Pawel Migdal et al., *The Influence of an Electromagnetic Field at a Radiofrequency of 900 MHz on the Behavior of a Honey Bee*, 15(12) Agriculture 1266 (2025), https://doi.org/10.3390/agriculture15121266.

i. The occurrence of behavioral disruption in rodents documented at 1 W/kg;[71]

ii. The EPA's previous conclusion that biological effects occur at a SAR of about 1 W/kg[72] in the context of EPA's effective defunding in 1996 and lack of serious study;

iii. Recent scientific literature reviews indicating adverse biological effects at drastically lower SAR levels such as 0.0165 W/kg, well below 1 W/kg;[73] and

iv. Record evidence indicating that certain RF radiation frequencies, like those used in the top ranges of 5G (above 6 GHz), can cause overheating in insects, including pollinators, due to factors such as a disruption or a harmful resonance that impacts the much smaller insect's feeding or propagation activities. This harmful resonance caused by non-naturally occurring (i.e., human-generated) polarized waveforms can increase energy absorption, potentially leading to overheating and biological disruption.[74]

4. Address Critical Omissions in SAR Testing Protocols Related to Real-World Use of Wireless Devices and Cumulative RF Exposures. The Commission must explain key gaps in its current SAR compliance testing protocols which call into question its ability to accurately assess RF radiation exposure under real-world conditions:

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[71] J.A. D'Andrea et al., *Behavioral Effects of Resonant Electromagnetic Power Absorption in Rats*, I Biological Effects of Electromagnetic Waves, Selected Papers of the USNC/URSI Annual Meeting, Boulder, Colorado, October 20–23, 1975 [257] (Oct. 20-23, 1975), https://ntrl.ntis.gov/NTRL/dashboard/searchResults/titleDetail/PB268094.xhtml (download PDF by clicking the red Adobe icon above the title). *See also* CTIA – The Wireless Assoc., *Erroneous Comments Submitted to the FCC on Proposed Cellphone Radiation Standards and Testing*, Reassessment of Federal Communications Commission Radiofrequency Exposure Limits and Policies, ET Docket No. 13-84 (Sept. 3, 2013), https://ehtrust.org/wp-content/uploads/2013/12/FCC-1.pdf.

[72] Health Effects Rsch. Lab'y, EPA, *Biological Effects Of RadioFrequency Radiation* at vi (1984) https://nepis.epa.gov/Exe/ZyPDF.cgi/300065H1.PDF?Dockey=300065H1.PDF.

[73] A review of 112 studies found that biological effects of RF radiation could occur at a median specific absorption rate of 0.0165 W/kg. *See* Henry Lai & B. Blake Levitt, *The roles of intensity, exposure duration, and modulation on the biological effects of radiofrequency radiation and exposure guidelines*, 41(2) Electromagnetic Biology & Med. 230 (2022), https://doi.org/10.1080/15368378.2022.2065683.

[74] "Different frequency ranges may adversely affect one species but have no impact on another. ICNIRP/IEEE/FCC's singular focus on heating effects may be particularly insupportable regarding insects, which can reach resonant matches with higher frequencies such as those used in the top ranges of 5G (>6 GHZ) due to insect's reduced size…Insects do not dissipate heat and can suffer extreme effects within short periods of exposure even in much lower ranges (< 3 GHZ), leading to reproductive problems and death…Existing exposure standards may prevent humans from heating effects due to thermo-regulatory mechanisms but not with other species such as insects, small amphibians and reptiles." B. Blake Levitt et al., *Low-level EMF effects on wildlife and plants: What research tells us about an ecosystem approach*, 10 Frontiers Pub. Health 1000840, 3 (2022), https://doi.org/10.3389/fpubh.2022.1000840. *See generally* Dimitris J. Panagopoulos ed., *Electromagnetic Fields of Wireless Communications: Biological and Health Effects* (2022).

i. Direct Body Contact: Why do current SAR testing protocols fail to reflect common, real-world use scenarios involving direct contact between wireless devices and the body (e.g. cell phones pressed against the head, laptops resting on the abdomen, wearable devices like "smart" swatches worn tightly against the skin, etc.)?

ii. Presence of Metal Objects: Why do SAR testing procedures not account for the presence of metal implants,[75] piercings, and jewelry, all of which have been shown to reflect, intensify, and redirect RF radiation emissions in unexpected ways, including ways that can increase localized exposure?[76]

iii. Cumulative and Ambient Exposures: How can compliance be assured when, in real-world environments, devices are often used simultaneously with other wireless technologies and within settings that include ambient RF radiation, resulting in aggregate RF radiation exposures?

5. Explain the "safety margin." The Commission's *2019 Order* asserts that changing the standardized cell phone and RF radiation-emitting device SAR testing positions to real-world use positions of 0 mm is "not necessary" due to the "large safety margin" included in the current limit.[77] However, evidence shows that the Commission's so-called "large safety margin" was arbitrarily derived, did not consider long-term chronic exposures, and was based on very limited and arbitrary animal studies that identified heat as the only harmful effect of RF radiation.[78]

[75] The "Metallic Implant Guidelines" of the International EMF Dosimetry Handbook states: "…in certain frequency ranges, there may be parts of the body where localized SAR levels are relatively high, and where additional SAR enhancement effect of the implant is more critical…Having established a base level of RF exposure in the body, the next step is to determine how the metal object perturbs and possibly concentrates the SAR around it. This should include a consideration of the following factors: 1) The size of the metal object, 2) The shape of the metal object, 3) Any gaps in the metal object, 4) Location of the metal object within the body, 5) Dielectric values of tissues around implanted medical objects, 6) Whether the implant traverses local tissue boundaries, 7) Orientation of the implant with respect to the local induced in vivo fields, 8) Distribution of the in vivo field around the implant (more important for large implants." *See* Vitas Anderson & Robert McIntosh, *Guidelines for the RF exposure assessment of metallic implants*, Int'l EMF Dosimetry Handbook (Oct. 2008), https://www.researchgate.net/publication/254340990_Guidelines_for_the_RF_exposure_assessment_of_metallic_implants at 6, 49. *See generally* FCC, OET Bull. No. 65, *supra* note 5 at 5.

[76] *See* Attachment 2.

[77] *2019 Order*, ¶ 14.

[78] "In the late-1990s, the FCC and ICNIRP adopted radiofrequency radiation (RFR) exposure limits to protect the public and workers from adverse effects of RFR. These limits were based on results from behavioral studies conducted in the 1980s involving 40–60-minute exposures in 5 monkeys and 8 rats, and then applying arbitrary safety factors to an apparent threshold specific absorption rate (SAR) of 4 W/kg. The limits were also based on two major assumptions: any biological effects were due to excessive tissue heating and no effects would occur below the putative threshold SAR, as well as twelve assumptions that were not specified by either the FCC or ICNIRP." (Emphasis added.) Int'l Comm'n on the Biological Effects of Electromagnetic Fields (ICBE-EMF), *supra* note 19.

The EPA, for example, typically implements safety factors in the 100s or 1,000s range, sometimes even as much as 10,000.[79] The FCC must adequately clarify safety factors for each type of RF radiation limit (whole body, local head/body, extremities, all MPE limits, occupational exposure limits, and limits for the general public) and provide science-based documentation on how the limit was developed for specific tissues. RF Hot spots, metal implants, the presence of metal jewelry, metal in clothing and hats, and many other factors require scientific assessment. The FCC specifically states that its local head/body SAR limits have a "large safety factor"[80] which was "derived from" a 50-fold safety factor.[81] However, the FCC has never clarified exactly what the "large safety margin" is for the local SAR head/body limit of 1.6 W/kg.

To comply with the remand regarding RF radiation base station and device testing method "safety factors," the Commission should:

i. Clearly describe and provide evidence-based documentation and justification for the baseline level of adverse biological effect that serves as the foundation for current RF radiation exposure limits.

ii. Specify the numerical safety factors applied to all RF exposure limits, including MPE and SAR thresholds for whole-body, localized (e.g., head and torso), and extremity exposures. This should include both occupational and general population exposure limits.

iii. Provide scientific evidence from studies, along with the Commission's technical rationale, substantiating the incorporation of a safety factor into the MPE limit, as well as whole-body, local, and extremity SAR limits.

iv. Demonstrate the adequacy of the applied safety factors in protecting various bodily tissues, particularly more sensitive tissues such as ocular, brain, blood, and gonadal tissues.

v. Provide clear justification for disregarding studies submitted into the record that challenge the existence or sufficiency of the claimed safety factors, including the basis for deeming such evidence irrelevant or scientifically insufficient.

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[79] Reply Comments of the Environmental Working Group, Proposed Changes in the Commission's Rules Regarding Human Exposure to Radiofrequency Electromagnetic Fields, ET Docket No. 13-84 (Nov. 19, 2013), https://www.fcc.gov/ecfs/document/6017477203/1 at 4.

[80] *2019 Order*, ¶ 14.

[81] In in its June 22, 2020 statement of interest in CTIA v. City of Berkeley, the FCC states: "The required notice suggests that an RF emission, at zero spacing from the body, might exceed the FCC's limits set at other distances, as previously described, and, therefore, poses a threat to human health. But the FCC's RF limits are set at a level on the order of 50 times below the level at which adverse biological effects have been observed in laboratory animals as a result of tissue heating resulting from RF exposure." Statement of Interest of the United States, CTIA v. City of Berkeley, No. 3:15-cv-2529-EMC, Ex. 1 (N.D. Cal. June 22, 2020), https://docs.fcc.gov/public/attachments/DOC-365069A1.pdf.

vi. Explain how the Commission's margin of error (±30%) is incorporated into RF exposure limits and compliance testing protocols.[82]

vii. For each use condition, provide a detailed and evidence-based explanation for how testing separation distance, exposure averaging time, and averaging mass of tissue were determined.

d. Additional Recommended Measures the FCC Should Undertake to Fulfill Its Congressionally-Mandated Obligation to Set RF Radiation Exposure Limits That Adequately Protect Human Health and the Environment.

1) Establish a Permanent Interagency Working Group. As the Commission itself acknowledges, it is not a specialized health or environmental agency. Thus, it must create a permanent Interagency Working Group to ensure that risk assessments and risk management decisions reflect the latest science on the biological and environmental effects of RF radiation. The Interagency Working Group should draw on the expertise of relevant federal agencies, including, but not limited to, the FDA, the NIH, the EPA, and the U.S. Fish and Wildlife Service ("USFWS"), to fulfill the Commission's stated goal of ensuring that "…[FCC] guidelines continue to be appropriate and scientifically valid."[83] To be effective, the Commission must require that participating agencies provide scientific updates and updates to safety guidance at least every twelve (12) months to ensure that all RF radiation exposure limits reflect the most current scientific research and are sufficient to protect public health and the environment.

2) Implement Pre-Market Testing for New and Emerging Technologies. A pre-market RF radiation safety testing program must be established for all new wireless technologies and previously untested GHz and THz frequency bands (such as those proposed for 6G and 7G networks[84]) to assess potential biological and environmental impacts before commercial

[82] A September 9, 2016, Swankin & Turner letter to the FCC about how peak spatial Specific Absorption Rate ("psSAR") tests have a margin of error remains unanswered by the FCC. Allowing this margin of error potentially exposes cell phone users to RF radiation above the FCC's 1.6 W/kg exposure limit. In fact, any phone with a SAR greater than 1.231 W/kg with the 30 percent margin of error can effectively exceed the 1.6 W/kg limit. Letter from James S. Turner, Swankin & Turner, to Howard Symons, General Counsel, FCC, & Bruce Romano, Assoc. Chief, Off. of Eng'g & Tech., FCC (Sept. 9, 2016), https://ehtrust.org/wp-content/uploads/Swankin-Turner-Letter-to-FCC-w-signature.pdf.

[83] Paragraph 4 of the FCC's *1996 Order* states: "We note that research and analysis relating to RF safety and health is ongoing, and we expect changes in recommended exposure limits will occur in the future as knowledge increases in this field. In that regard, we intend to continue our cooperative work with industry and with the various agencies and organizations with responsibilities in this area in order to ensure that our guidelines continue to be appropriate and scientifically valid." Report and Order, Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation, ET Docket No. 93-62 (adopted Aug. 1, 1996), https://transition.fcc.gov/Bureaus/Engineering_Technology/Orders/1996/fcc96326.pdf at 3.

[84] The Commission took steps to allow the development of new equipment and applications for spectrum between 95 GHz and 3 THz, stating: "The rules we adopt in this First Report and Order will permit enhanced experimental licensing and unlicensed applications within this spectrum band as well as advance our overall commitment to identify and make available unused and underused spectrum regardless of the frequency range." First Report and Order, Spectrum Horizons, ET Docket No. 18-21 (adopted Mar. 15, 2019), https://docs.fcc.gov/public/attachments/FCC-19-19A1_Rcd.pdf at 1605-06. "We are not adopting rules on RF exposure requirements at this time…All RF exposure requirements will be addressed in the ongoing proceeding in

deployment. In parallel, updated RF radiation safety limits must be developed and enacted that address the unique nature of these significantly higher RF frequencies.

3) Modernize Pre-Market SAR Testing Procedures to Reflect Real-World Usage Patterns of Cell Phones and Other Wireless Devices. The Commission must update its SAR compliance testing protocols to reflect real-world usage patterns of wireless devices. Current protocols fail to account for direct device-to-body contact, despite the widespread and routine use of wireless devices in such positions (e.g., cell phones in pant pockets, laptops resting on the abdomen, and "smart" watches worn tightly against the wrist). Additionally, existing SAR testing configurations, which are limited to cheek and tilt positions, are insufficient. By allowing the ear (pinna) to function as a spacer between the device and the skull, actual RF radiation exposure levels are underestimated.[85] Testing for all wireless devices, prior to release to the public, should occur at 0 mm separation for both head and body RF radiation exposure assessments to ensure real public health protection, and should account for both biological and thermal impacts.

Secondly, the SAM model used during SAR testing, which represents a 220-pound male with a 12-pound head, is not representative of the wide range of individuals who use wireless technologies in the United States today.[86] Age-specific and tissue-specific models and simulations, with representative adult, pregnancy, and child models, should be used to assess RF radiation exposure levels from cell phones and other wireless devices in real-world positions to more accurately estimate one's RF radiation exposure from a particular wireless device.

4) Require Clear and Accessible RF Radiation Exposure Information for Consumers. If the Commission continues to put the public at risk by determining that cell phones and other wireless devices can be tested with a significant separation distance between the device and the body, then the Commission must develop and promulgate regulations that require device manufacturers to inform consumers about the separation distance needed between the consumer's body and his/her device to ensure that his/her RF radiation exposure from that device will remain within federal limits. Currently, limited RF radiation exposure information is buried deep in device safety manuals which few consumers read or know exist; thus, such warnings are virtually useless to the everyday person. For example, the iPhone 16 Pro's information can be found by first navigating to the phone's "Settings" menu.

ET Docket No. 13-84." Id. at 1625, fn. 114. *See also* Vitaly Petrov et al., *Mobile near-field terahertz communications for 6G and 7G networks: Research challenges*, 4 Frontiers Commc'ns & Networks 1151324 (2023), https://doi.org/10.3389/frcmn.2023.1151324.

[85] Om P. Gandhi & Gang Kang, *Inaccuracies of a plastic "pinna" SAM for SAR testing of cellular telephones against IEEE and ICNIRP safety guidelines*, 52(8) IEEE Transactions on Microwave Theory & Techs. 2004 (2004), https://doi.org/10.1109/TMTT.2004.832689.

[86] "…it is very hard to understand why the FCC allows the use of a large SAM model of dimensions derived from the 90th percentile head size of the U.S. Military recruits for psSAR compliance testing against safety guidelines. Furthermore, the FCC-accepted SAM model has a tapered smooth plastic spacer instead of actual tissue pinna which can artificially separate the radiofrequency radiation source of the mobile phone by up to 10 millimeters at some locations resulting in an underestimation of both 1- and 10-g psSAR for male heads and for children and women by two or more times." Om P. Gandhi, *supra* note 10.

Once there, click “General.” Then scroll to the very bottom of the menu and select “Legal & Regulatory.” Finally, select “RF Exposure.”

5) Create a Comprehensive RF Radiation Compliance Oversight Program. The Commission currently lacks sufficient transparency, oversight, and surveillance mechanisms to ensure that wireless devices and wireless infrastructure comply with its RF radiation limits. Exceedances of the Commission’s RF radiation human exposure limits have been documented in RF radiation emissions testing of cell phones and base station antennas such as rooftop antennas.[87, 88, 89] RF radiation monitoring systems should ensure a focus on sensitive populations (e.g., schools, daycare facilities, and parks) and “ecologically sensitive areas” as identified by EPA, the Department of the Interior (“DOI”), Bureau of Land Management (“BLM”), National Marine Fisheries Service (“NMFS”), USFWS, and the U.S. Army Corps of Engineers (“USACE”).

Real-time monitoring for RF radiation exposure emissions are entirely possible.[90] The French government makes RF radiation measurements from base stations publicly available.[91] The French National Frequency Agency (“ANFR") has installed RF monitoring devices in Paris and other cities to collect data on 5G health impacts.[92] The ANFR launched a website offering live data on RF radiation exposure around 5G sites.[93] In Australia, the Radio Frequency National Site Archive (“RFNSA”), developed by the Australian Mobile Telecommunications Association (“AMTA”), allows users to search for base stations throughout the country and access information about them, including Electromagnetic

[87] The case record in Block v. Nokia, No. 2015 CA 002114 B, and specifically, Plaintiff’s Opposition to Defendants’ Motion to Dismiss, includes documentation of precision measurements taken by a professional engineer using an FCC-certified lab and professional grade calibrated radio spectrum analyzers. The measurements collected demonstrate non-compliance with FCC base station RF radiation standards and non-compliance with FCC wireless device RF radiation standards.

[88] RF Exposure Analysis performed at 2701 Connecticut Avenue, NW, Washington, DC by Cardinal Communications, a Division of Thought Delivery Systems, Inc. for THE BALANCE GROUP. Using Crest Factor analysis, measurements revealed that RF radiation emissions generated by the wireless facility located at 2701 Connecticut Avenue, NW, Washington DC routinely spiked to 132-to-264% beyond the Commission’s human RF radiation exposure limit. *See* Americans for Responsible Technology et al., Citizen Petition to the U.S. Dep’t of Health & Hum. Serv. & FDA (Dec. 20, 2021) at 236-242, https://ehtrust.org/wp-content/uploads/2021-12-21-HHS_FDA-Petition-Final-Filed.pdf.

[89] In 2012, The EMRadiation Policy Institute measured exceedances of 600% of the public limit as well of 100% of occupational limits at multiple wireless antenna sites in Missouri. These findings were the basis of a Senate inquiry to the Commission. *See* Memorandum from Janet Newton, President, The EMRadiation Policy Institute to P. Michele Ellison, Enf’t Bureau Chief, FCC (Feb. 27, 2012), https://ehtrust.org/wp-content/uploads/230-South-Bemiston-Ave-EB-FIELDSCR-12-00001413_Complaint.pdf.

[90] For example, the Waterford RF Infrastructure Sentry system conducts RF radiation emission and exposure monitoring but also provides video monitoring to assist with signage, fencing, and personnel entry and exit compliance. *See* RF Infrastructure Sentry, *The Product*, rfis.com, https://rfis.com/index.php/product/ (last visited May 27, 2025).

[91] *France – Policy Recommendations on Cell Phones, Wireless Radiation & Health*, EHT (May 8, 2017), https://ehtrust.org/france-policy-recommendations-cell-phones-wireless-radiation-health/.

[92] *5G Cell Towers in Paris Equipped with Radiation Measurement Devices by French Government*, EHT (Nov. 24, 2020), https://ehtrust.org/5g-cell-towers-in-paris-equipped-with-radiation-measurement-devices-by-france/.

[93] *French spectrum agency launches live data tool on radiation near 5G sites*, Telecompaper (May 1, 2020), https://www.telecompaper.com/news/french-spectrum-agency-launches-live-data-tool-on-radiation-near-5g-sites--1336941?fbclid=IwAR2KsgpWW9zX1OdrKPaprUBUvt1DX3-M4Lc1l2qloy0OupJrJStp0lnD_T8.

Energy ("EME") reports.[94] In Israel, the Noise Prevention and Radiation Safety Department, part of the Ministry of Environmental Protection, is tasked with reducing the public's exposure to RF radiation. To do so, it supervises parties dealing with sources of non-ionizing and ionizing radiation and uses monitoring stations throughout the country to track environmental background radiation.[95] If France, Australia, Israel, and other advanced, developed countries can conduct real-time RF radiation monitoring, so can (and should) the United States.

6) Establish a National Registry for Wireless Facilities. The Commission should establish a National Registry for all licensed and unlicensed wireless communication transmission facilities.[96] The registry should include, without limitation, cell towers, wireless network base station network antennas, and "small cells." Such a National Registry should also include historical RF radiation compliance data. All collected EMF data must be free and available online to the public.

In addition, the Commission should establish a health effects registry for individuals to report health effects associated with or linked to RF radiation exposure emitted by wireless devices and wireless telecommunications facilities. Such an effort could be modeled after the FDA's MedWatch program for reporting medical product safety information and adverse events.[97]

7) Establish Standards for RF Radiation Compliance Test Reporting. Currently, there is no standardization for RF radiation compliance reporting. The Commission should establish such standards for wireless facility RF compliance test reports and RF radiation exposure simulations based on empirical data, which should be made publicly available so that the public can see the methods used and the radiation exposure levels in real-time, prior to deciding to visit a location or to rent or purchase a property. The real-time "radiation weather" reports available in Australia, France and Israel are notable examples from which to start setting a national standard. Additionally, in accordance with professional grade harmful interference RF exposure assessments, the make and model of the radio spectrum analyzer must be noted, whether and when is has been calibrated, and whether it is capable of assessing all the spectrum bands to which the public is being exposed. Further, the reports must indicate if the spectrum analyzers and antenna probes used were operated by a certified spectrum manager or professional engineer ("P.E.") or similarly trained and certified technician.

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[94] *Radio Frequency National Site Archive*, https://www.rfnsa.com.au/?first=1 (last visited July 16, 2025).
[95] *Ionizing and Non-Ionizing Radiation Department*, Israeli Ministry of Environmental Protection, https://www.gov.il/en/departments/units/noise_and_radiation_prevention_dept (last visited July 16, 2025).
[96] Transmission equipment is defined in 47 C.F.R. § 1.6100(b)(8) as: "Equipment that facilitates transmission for any Commission-licensed or authorized wireless communication service, including, but not limited to, radio transceivers, antennas, coaxial or fiber-optic cable, and regular and backup power supply. The term includes equipment associated with wireless communications services including, but not limited to, private, broadcast, and public safety services, as well as unlicensed wireless services and fixed wireless services such as microwave backhaul."
[97] *See* FDA, *MedWatch: The FDA Safety Information and Adverse Event Reporting Program*, fda.gov, https://www.fda.gov/safety/medwatch-fda-safety-information-and-adverse-event-reporting-program (last visited July 8, 2025).

2. The Commission is Required to Address the Impacts of RF Radiation on Children.

a. Background.

Children absorb proportionately higher peak RF radiation doses from cell phones and wireless devices into their brains and bodies than adults.[98] Children also have higher metabolic rates, an immature immune system, and physiological characteristics which render them more biologically sensitive to RF radiation exposures (e.g., thinner skulls, smaller heads, and higher brain conductivity than adults).

Children use cell phones and other wireless devices in ways and in durations that the Commission could not have accounted for when it set its 1996 RF radiation limits. According to Common Sense Media, 40% of children today have a tablet by age 2, and nearly 1 in 4 have a personal cellphone by age 8.[99] For children under 2 years of age, average daily screen use is approximately 1 hour, whereas 2–4-year-olds average over 2 hours per day.[100] Children between 5 and 8 years-old average almost 3.5 hours per day.[101] A 2024 CDC data brief concluded that, during July 2021 through December 2023, 50.4% of teenagers ages 12-17 had 4 hours or more of daily screen time.[102] These unprecedented RF radiation exposure patterns underscore an urgent need for the Commission to adopt RF radiation protections that acknowledge and address modern usage and provide real RF radiation safeguards for young users.

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[98] *See* Attachment 3.
[99] Common Sense Media, *The 2025 Common Sense Census: Media Use by Kids Zero to Eight* (Feb. 26, 2025), https://www.commonsensemedia.org/research/the-2025-common-sense-census-media-use-by-kids-zero-to-eight.
[100] Id. at 1.
[101] Id.
[102] Benjamin Zablotsky, et al., *Daily Screen Time Among Teenagers: United States, July 2021-December 2023*, NCHS Data Brief No. 513 (Oct. 2024), https://www.cdc.gov/nchs/data/databriefs/db513.pdf.

b. Description Of Significant Record Deficiencies and Updated Post-Decision Evidence.

In its *2013 Inquiry*, the Commission requested comments on the effects of RF radiation on children, stating: "The Commission invites health and safety agencies and the public to comment on the propriety of our general present limits and whether additional precautions may be appropriate in some cases, for example with respect to children."[103] Many scientists, medical doctors, and organizations urged the adoption of more stringent RF radiation safeguards for children, citing scientific evidence that children's developing brains, organs, and bodily systems are more sensitive and uniquely vulnerable to RF radiation exposure than adults. And yet, the Commission ignored these warnings.

For instance, the American Academy of Pediatrics ("AAP") wrote to the Commission in 2013 to advocate for the "reassessment of radiation standards for cell phones and other wireless products and the adoption of standards that are protective of children and reflect current use patterns."[104] On the AAP's website, the AAP states: "…the cell phone radiation test used by the FCC is based on the devices' possible effect on large adults – not children. Children's skulls are thinner and can absorb more radiation." [105] Several scientific papers, including some published after the *2019 Order* was enacted, have concluded that additional RF radiation protections are needed during childhood and pregnancy.[106, 107] Additionally, an analysis of the NIH National

[103] *2013 Notice of Inquiry*, *supra* note 42 at ¶ 6.
[104] Letter from Thomas K. McInerny, President, Am. Acad. of Pediatrics, to Mignon L. Clyburn, Acting Comm'r, FCC, & Margaret A. Hamburg, Comm'r, FDA (Aug. 29, 2013), https://ehtrust.org/wp-content/uploads/7520941318.pdf at 2.
[105] American Acad. of Pediatrics, *Cell Phone Radiation & Children's Health: What Parents Need to Know* (last updated June 13, 2016), https://www.healthychildren.org/English/safety-prevention/all-around/Pages/Cell-Phone-Radiation-Childrens-Health.aspx.
[106] Julie E. McCredden et al., *Wireless technology is an environmental stressor requiring new understanding and approaches in health care*, 10 Frontiers Pub. Health 986315 (2022), https://doi.org/10.3389/fpubh.2022.986315.
[107] Int'l Comm. on the Biological Effects of Electromagnetic Fields, *Scientific evidence invalidates health assumptions underlying the FCC and ICNIRP exposure limit determinations for radiofrequency radiation: implications for 5G*, 21 Env't Health 92 (2022), https://doi.org/10.1186/s12940-022-00900-9.

Toxicology Program ("NTP") study concluded that the Commission's RF radiation limits should be reduced by at least 200 to 400 times to adequately protect children.[108] Disturbingly, follow-up studies to the NTP study have been halted.[109]

c. Recommended Approaches to Comply with the Remand and Address the Subject Impacts.

As previously stated, the Commission should clearly specify the safety factors applied to both whole-body and local SAR, as well as MPE limits, and provide the scientific rationale supporting such safety factors. This evaluation must also explicitly address children's unique biological vulnerabilities to RF radiation. Additionally, the Commission must address the record evidence and post-decision scientific publications regarding:

i. Constant, cumulative RF radiation exposure to the fetus, newborns, and children in various settings and in various states of health (e.g., medically compromised infants in neonatal intensive care units, etc. [110]).

ii. Heightened sensitivity of the brain, endocrine, reproductive, and immune systems in children and fetuses to RF radiation during critical periods of development.[111]

iii. Public health and medical expert recommendations urging the adoption of a more restrictive RF radiation limit, a stronger safety factor, and the

[108] *Supra* note 25.
[109] "The recent disclosure of the U.S. National Toxicology Program (NTP) closing down its RF radiation research program on how RF radiation causes cancer was a surprise. NTP is a part of the NIH and reports to the U.S. Department of Health and Human Services. NTP's mandates are to provide the scientific basis for programs, activities, and policies that promote health or lead to the prevention of disease." *See* James C. Lin, *Follow-Up Research on NTP's Clear Evidence on RF Causing Malignant Tumors in Rats*, 25(6) IEEE Microwave Mag. 16 (2024), https://doi.org/10.1109/MMM.2024.3378608. *See also*, J. M. Moskowitz, "*The National Toxicology Program of the National Institute of Environmental Health Sciences announced it will no longer study the effects of radio frequency radiation*," Electromagnetic Radiation Safety (Jan. 17, 2024), https://www.saferemr.com/2024/01/; D. Davis, "*Why did NIH abruptly halt research on the harms of cell phone radiation?*" The Hill (Feb. 1, 2024), https://thehill.com/opinion/technology/4437988-why-did-nih-abruptly-halt-research-on-the-harms-of-cell-phone-radiation/; "*U.S. NTP Quits RF: Promised studies on mechanisms never done*," Microwave News (Feb. 2, 2024), https://microwavenews.com/news-center/ntp-quits-rf.
[110] *See* Attachment 4.
[111] *See* Attachment 5.

implementation of government policies to reduce RF radiation exposure for children and the developing fetus.[112]

iv. Studies indicating that the SAM test is neither a conservative nor relevant model for measuring RF radiation exposure levels for children and the developing fetus.[113]

d. Additional Measures the Commission Should Undertake to Fulfill its Congressionally-Mandated Obligation to Set RF Radiation Exposure Limits that Adequately Protect Children.

The Commission should take meaningful steps to inform parents, caregivers, and school officials about children's unique biological vulnerabilities to RF radiation and existing scientific data concerning the lifelong effects of childhood exposure to RF radiation. The AAP has emphasized this concern, stating: "The AAP supports the review of radiation standards for cell phones in an effort to protect children's health, reflect current cell phone use patterns, and provide meaningful consumer disclosure. Providing parents with information about any potential risks arms them with the information they need to make informed decisions for their families."[114] In light of this, the Commission should actively educate the public on practical ways to reduce children's RF radiation exposures from common sources like cellphones, Wi-Fi access points, laptops, tablets, wireless game consoles, "smart" speakers, and other wireless-enabled devices. Areas where children live, play, and attend school should be designated as "sensitive areas" afforded additional RF radiation protections (e.g., strengthened oversight and compliance with RF radiation MPE limits, required installation setbacks for wireless infrastructure, etc.).

[112] "Concerns for children's exposure are warranted due to the amazingly rapid uptake of many wireless devices by increasingly younger children." *See* Mary Redmayne, *International policy and advisory response regarding children's exposure to radio frequency electromagnetic fields (RF-EMF)*, 35(2) Electromagnetic Biology & Med. 176 (2015), https://doi.org/10.3109/15368378.2015.1038832.
[113] *See* Attachment 6.
[114] AAP, *Cell Phone Radiation & Children's Health: What Parents Need to Know*, *supra* note 105.

Further, the Commission must recognize and respond to the fact that numerous countries have already enacted regulations limiting RF radiation exposure in environments where young children spend extended periods of time. For example, on January 29, 2015, France passed a law prohibiting the installation of fixed terminal equipment equipped with wireless internet access where children under three years of age rest and play.[115] The law also requires mobile operators to provide an accessory to limit head exposure to wireless radiation emissions from wireless devices for children under 14 years old.[116] In June of 2014, Ghent, Belgium banned Wi-Fi from pre-schools and daycare centers.[117] Earlier that same year, mobile phones designed specifically for children under seven years of age were banned from the Belgian market.[118] All mobile phone advertising for children under seven years of age was also banned.[119] In March of 2013, the Australian Radiation Protection and Nuclear Safety Agency issued a recommendation that parents limit children's use of wireless devices.[120] In 2012, Israel's Deputy Health Minister, Yaakov Litzman, called for Education Minister, Gideon Sa'ar, to suspend the installation of wireless routers in schools due to wireless radiation health hazards.[121] In 2008, the City of Lyon, France, launched a campaign discouraging cell phone use by children under the age of 12.[122]

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[115] Assemblée Nationale, *Sobriété De L'Exposition Aux Champs Électromagnétiques, Information Et Concertation Lors De L'Implantation D'Installations Radioélectriques*, Texte adopté n° 468 (Fr.), https://www.assemblee-nationale.fr/14/ta/ta0468.asp.

[116] Id.

[117] Andy Furniere, *Ghent bans wi-fi from pre-schools and day care*, Flanders Today, June 16, 2014 https://www.flanderstoday.eu/education/ghent-bans-wi-fi-pre-schools-and-day-care.

[118] Fed. Pub. Serv., Health Food Chain Safety and Env't, *New rules for selling mobile phones: Frequently Asked Questions*, https://www.health.belgium.be/sites/default/files/uploads/fields/fpshealth_theme_file/19099488/FAQ_KBs_mobiele_telefoon_version5_EN.pdf (last visited July 15, 2025).

[119] Id.

[120] French Agency for Food, Env't and Occupational Health & Safety, *ANSES makes recommendations to limit exposure to radio frequencies*, Oct. 15, 2013, https://www.anses.fr/fr/content/lanses-formule-des-recommandations-pour-limiter-les-expositions-aux-radiofrequences.

[121] Philip Podolsky, *Stop Wi-Fi in schools*, *deputy health minister implores,* Times of Israel (Aug. 23, 2012), https://www.timesofisrael.com/stop-wi-fi-in-schools-deputy-health-minister-implores/.

[122] *A Mobile Phone Before We're 12, No Way!,* City of Lyon, France, https://3.bp.blogspot.com/-docuyRWRdx8/UxGoEEC5dHI/AAAAAAAAXNg/A3sPJ-U0tmA/s1600/111lyon20advertjpeg.jpg.

3. The Commission Must Address Non-Cancerous Health Impacts of Long-Term RF Radiation Exposure.

a. Background.

The Court found the Commission's *2019 Order* "arbitrary and capricious in its failure to respond to record evidence that exposure to RF radiation at levels below the Commission's current limits may cause negative health effects unrelated to cancer."[123] The Court also mandated that the Commission address "the health implications of long-term exposure to RF radiation."[124] These major failures undermine the Commission's conclusions regarding the adequacy of current RF radiation testing procedures, particularly as they relate to children, and its conclusions regarding: 1) the implications of long-term exposure to RF radiation, 2) exposure to RF pulsation or modulation, and 3) technological developments that have occurred since 1996, including the ubiquity of wireless devices and the emergence of "5G" technology.[125]

On May 19, 1999, the FDA requested that the NTP perform cell phone radiation animal studies because, "The existing exposure guidelines are based entirely on protection from acute injury from thermal effects of RFR exposure, and may not be protective against any non-thermal effects of chronic exposures…well-planned animal experiments is needed to provide the basis to assess the risk to human health of wireless communications devices."[126] Three years later, EPA responded to a concerned citizen regarding the adequacy of the Commission's RF radiation exposure limits: "The FCC's current exposure guidelines, as well as those of the Institute of Electrical and Electronics Engineers (IEEE) and the International Commission of Non-ionizing

[123] EHT v. FCC, 9 F.4th at 903.
[124] Id. at 914.
[125] Id. at 902.
[126] FDA, *Nominations from FDA's Center from Device and Radiological Health: Radio Frequency Radiation Emissions of Wireless Communication Devices (CDRH)* (May 19, 1999), https://ntp.niehs.nih.gov/sites/default/files/2024-10/wireless051999_508.pdf.

Radiation Protection, are thermally based, and do not apply to chronic, nonthermal exposure situations...The FCC's exposure guideline is considered protective of effects arising from a thermal mechanism but not from all possible mechanisms."[127] EPA confirmed this serious omission in limit-setting adequacy: "The exposure guidelines did not consider information that addresses nonthermal, prolonged exposures, i.e., from research showing effects with implications for possible adversity in situations involving chronic/prolonged, low-level (nonthermal) exposures."[128, 129]

b) Description of Significant Record Deficiencies and Updated Post-Decision Evidence.

The Commission failed to review and consider scientific studies indicating adverse biological effects from long-term exposure to non-thermal RF radiation levels unrelated to cancer submitted to the *2013 Notice of Inquiry* administrative record. Among the scientific studies disregarded by the Commission is a scientific literature review which found that, out of 100 peer-reviewed studies, 93 confirmed that RF radiation induces oxidative effects in biological systems.[130] Chronic exposure to oxidative stress can lead to inflammation, and chronic inflammation is understood to play a significant role in a wide variety of age-related diseases including diabetes, cardiovascular disease, and autoimmune diseases.[131] Foerster et al. (2018)

[127] Letter to Janet Newton, President, The EMR Network, from Norbert Hankin, Ctr. for Sci. and Risk Assessment, Radiation Prot. Div., EPA (July 16, 2002), https://ehtrust.org/wp-content/uploads/EPA-Hankin-Letter-2002.pdf at 2.
[128] Id.
[129] On September 23, 2014, George Brozowski, a regional health physicist for the EPA, wrote that the Commission's RF radiation limits are "…intended to prevent adverse health effects that may be associated with tissue heating, but are not intended to address low intensity (non-thermal), long-term (chronic) exposures." *See* Letter from George Brozowski, Reg'l Health Physicist, EPA to Redacted Individual (Sept. 23, 2014), https://ehtrust.org/wp-content/uploads/827eb44b0a8e5417c3fa1858ab61bc11.pdf
[130] Igor Yakymenko et al., *Oxidative mechanisms of biological activity of low-intensity radiofrequency radiation*, 35(2) Electromagnetic Biology & Med. 186 (2016), https://doi.org/10.3109/15368378.2015.1043557.
[131] E. Matteucci & O. Giampietro, *Building a Bridge Between Clinical and Basic Research: The Phenotypic Elements of Familial Predisposition to Type 1 Diabetes*, 14(5) Current Med. Chem. 555 (2007), http://dx.doi.org/10.2174/092986707780059689.

which examined adolescents who used cell phones over the course of one year and found memory impairments associated with cumulative RF exposure to the brain.[132]

Post-decision scientific studies further corroborate strong evidence that long-term exposure to RF radiation triggers troubling biological effects. A 2025 World Health Organization-commissioned review analyzed 52 animal studies, concluding that RF radiation from cell phones increases the risk of gliomas and malignant heart schwannomas (i.e., nerve tumors) in male rats, and found, with moderate certainty, an increased risk of liver and adrenal gland tumors.[133] A 2024 study by Omid Yaghmazadeh of the Neuroscience Institute of New York University's School of Medicine concluded that "high-power sub-millisecond radio frequency energy pulses can induce neurological and neuropathological changes in the brain while being compliant with current regulatory guidelines' limits." [134] A 2023 study conducted by U.S. military researchers reported 114 significantly differentially methylated genes in human skin cells following a single, one-hour exposure at levels below 0.01 W/Kg — a fraction of the Commission's current RF radiation limits.[135] Perov et al. (2023) exposed rats to non-thermal levels of RF radiation for four months, simulating the effects of 5G NR/IMT-2020 mobile communication systems.[136] The results suggest that "exposure to multifrequency electromagnetic

[132] Milena Foerster et al., *A Prospective Cohort Study of Adolescents' Memory Performance and Individual Brain Dose of Microwave Radiation from Wireless Communication*, 126(7) Env't Health Persps. 0077007 (2018), https://doi.org/10.1289/EHP2427.
[133] Meike Mevissen et al., *Effects of radiofrequency electromagnetic field exposure on cancer in laboratory animal studies, a systematic review*, 199 Env't Int'l 109482 (2025), https://doi.org/10.1016/j.envint.2025.109482.
[134] Omid Yaghmazadeh, *Pulsed High-Power Radio Frequency Energy Can Cause Non-Thermal Harmful Effects on the BRAIN*, 5 IEEE Open J. Eng'g Med. & Biology 50 (2024), https://doi.org/10.1109/OJEMB.2024.3355301.
[135] Jody C. Cantu et al., *Analysis of global DNA methylation changes in human keratinocytes immediately following exposure to a 900 MHz radiofrequency field*, 44 Bioelectromagnetics 77 (2023), https://doi.org/10.1002/bem.22439.
[136] S. Yu Perov et al., *Status of the Neuroendocrine System in Animals Chronically Exposed to Electromagnetic Fields of 5G Mobile Network Base Stations*, 174 Bull. Experimental Biology & Med. 277 (2022), https://doi.org/10.1007/s10517-023-05689-2.

field simulating the effects of 5G systems affected functional activity of the hypothalamus – pituitary – adrenal axis and was stressful in nature."[137]

Canturk et al. (2022) examined pre- and post-natal exposure of rats to 2450 MHz RF radiation for 12 hours per day over four generations and found effects on the thymus of the fourth-generation offspring in the group where both male and female parents were exposed.[138] Barnes and Freeman (2022)[139] conclude, "It is now well established that biological systems respond to exposure to weak EM fields at energy levels well below the current safety guidelines which result in modification of their functionality without significant changes in temperature." Schuermann and Mevissen's 2021 review on oxidative stress concludes that: "Most animal and many cell studies showed increased oxidative stress caused by RF-EMF…EMF exposure, even in the low dose range, may well lead to changes in cellular oxidative balance."[140] Yu et al. (2020) found that RF radiation emitted by a 4G smartphone caused decreased sperm quality and pup weight, along with testicular injury, in male rats following 150 days of exposure.[141]

Synergistic effects from combined exposure to long-term, non-thermal levels of RF radiation and other environmental hazards have also been documented in post-decision scientific publications.[142] For example, Panagopoulos (2024) concluded that "…the combination of various doses of gamma radiation with a 15-min exposure to a 3G/4G mobile phone (with

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[137] Id.
[138] Fazile Cantürk Tan et al., *Effects of pre and postnatal 2450 MHz continuous wave (CW) radiofrequency radiation on thymus: Four generation exposure*, 41(3) Electromagnetic Biology & Med. 315 (2022), https://doi.org/10.1080/15368378.2022.2079673.
[139] Frank Barnes & Eugene R. Freeman, Jr., *Some thoughts on the possible health effects of electric and magnetic fields and exposure guidelines*, 10 Frontiers Pub. Health 994758 (2022), https://doi.org/10.3389/fpubh.2022.994758.
[140] David Schuermann & Meike Mevissen, *Manmade Electromagnetic Fields and Oxidative Stress—Biological Effects and Consequences for Health*, 22(7) Int'l J. Molecular Sci. 3772 (2021), https://doi.org/10.3390/ijms22073772.
[141] Gang Yu et al., *Long-term exposure to 4G smartphone radiofrequency electromagnetic radiation diminished male reproductive potential by directly disrupting Spock3–MMP2-BTB axis in the testes of adult rats*, 698 Sci. Total Env't 133860 (2020), https://doi.org/10.1016/j.scitotenv.2019.133860.
[142] *See* Attachment 7.

disabled Wi-Fi and Bluetooth functions) increased greatly and in some cases nearly doubled the effects of gamma radiation in all subjects…Thus, mobile telephony EMF exposure ~136 times below ICNIRP (2020) limits…significantly enhanced the genotoxic action of gamma radiation when the two stressors were combined."[143] Benavides et al. (2023) found high levels of oxidative stress associated with black carbon and RF radiation, suggesting that "an environmental context where both stressors occur together may facilitate or accelerate mechanisms that lead to inflammatory response, cell injury and diverse pathologies in living beings."[144] Patrignoni et al. (2023) reported that a single 24-hour exposure to a 5G signal at 3.5 GHz significantly altered mitochondrial reactive oxygen species production in human skin fibroblasts and human keratinocytes following UV-B irradiation.[145] A 2018 editorial published in "Toxicology Reports" states: "Examination of thousands of Medline abstracts showed typically that combinations of toxic stimuli can produce damage even when the exposure level of each member of the combination is less than the lowest exposure level of the member that produced damage when tested in isolation… The conclusion is applicable to essentially all potential contributing factors to disease amenable to Exposure Limits, including not only chemicals but other types of exposures such as radiofrequency radiation (RFR)."[146] A 2017 textbook titled "Microwave Effects on DNA and Proteins" states: "…non-ionizing EMF radiation exposure safety standards

[143] Dimitris J. Panagopoulos, *Mobile telephony radiation exerts genotoxic action and significantly enhances the effects of gamma radiation in human cells*, 43(2) Gen. Physiology & Biophysics 103 (2024), https://doi.org/10.4149/gpb_2023036.
[144] Rosa Ana Sueiro Benavides et al., *The HL-60 human promyelocytic cell line constitutes an effective in vitro model for evaluating toxicity, oxidative stress and necrosis/apoptosis after exposure to black carbon particles and 2.45 GHz radio frequency*, 867 Sci. Total Env't 161475 (2023), https://doi.org/10.1016/j.scitotenv.2023.161475; Rosa Ana Sueiro-Benavides et al., *Radiofrequency at 2.45 GHz increases toxicity, pro-inflammatory and pre-apoptotic activity caused by black carbon in the RAW 264.7 macrophage cell line*, 765 Sci. Total Env't 142681 (2021), https://doi.org/10.1016/j.scitotenv.2020.142681.
[145] Lorenza Patrignoni et al., *Evaluation of mitochondrial stress following ultraviolet radiation and 5G radiofrequency field exposure in human skin cells*, 45 Bioelectromagnetics 110 (2024), https://doi.org/10.1002/bem.22495.
[146] Ronald N. Kostoff et al., *The role of toxic stimuli combinations in determining safe exposure limits*, 5 Toxicology Reps. 1169 (2018), https://doi.org/10.1016/j.toxrep.2018.10.010.

are based primarily on stand-alone radiation exposures. When combined with other agents, the adverse effects of non-ionizing EMF radiation on biological systems may be more severe."[147] A 2013 study concluded that simultaneous exposure to lead and RF radiation from mobile phone is associated with increased risk of Attention-Deficit/Hyperactivity Disorder.[148]

b. Recommended Approaches to Comply with the Remand and Address the Subject Impacts.

In 1999, the U.S. government's Radiofrequency Interagency Work Group ("RFIAWG") wrote a letter to an IEEE workgroup stating: "The past approach of basing the exposure limits on acute effects data with an extrapolation to unlimited chronic exposure durations is problematic."[149] RFIAWG recommended that the IEEE guidelines—on which the Commission relied in adopting its 1996 RF radiation exposure limits—include a review addressing: 1) long-term, low-level exposure studies, 2) neurological/behavioral effects, and 3) micronucleus assay studies.[150] Disturbingly, the RFIAWG's scientific recommendations have gone unaddressed by the Commission for over two decades.

In light of the Court's mandate, the Commission must address long-term, non-cancerous exposure effects of RF radiation and review scientific studies which have found the following non-cancerous, adverse biological effects:

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[147] Ronald N. Kostoff & Clifford G.Y. Lau, *Modified Health Effects of Non-ionizing Electromagnetic Radiation Combined with Other Agents Reported in the Biomedical Literature*, *in* Microwave Effects on DNA and Proteins 97 (Chris D. Geddes ed., 2017), https://doi.org/10.1007/978-3-319-50289-2_4.
[148] Yoon-Hwan Byun et al., *Mobile Phone Use, Blood Lead Levels, and Attention Deficit Hyperactivity Symptoms in Children: A Longitudinal Study*, 8(3) PLOS ONE e59742 (2013), https://doi.org/10.1371/journal.pone.0059742.
[149] Letter from W. Gregory Lotz, Chief, Physical Agents Effects Branch, Div. of Biomedical & Behavioral Scis., Nat'l Inst. for Occupational Safety & Health, to Richard Tell, Chair, IEEE SCC28 (SC4) Risk Assessment Work Group (June 17, 1999), https://ehtrust.org/wp-content/uploads/2016/04/1999-radiofrequency-interagency-workgroup-letter.pdf.
[150] Id. at 7.

1. Impacts on organismal and cellular biochemical function, including increased oxidative stress, reactive oxygen species/free radical overproduction, mitochondrial function, voltage-gated channels, and calcium homeostasis;[151]

2. Neurological impacts, including, but not limited to, impacts to neurotransmitters, altered glucose metabolism, and electroencephalogram changes;[152]

3. Cognitive impacts, including, but not limited to, memory damage, behavioral changes, increased hyperactivity, decreased attention span, and developmental impacts;[153]

4. Structural damage to the brain, including to the blood brain barrier;[154]

5. Increases in headaches and migraines;[155]

6. RF radiation-related illness;[156, 157]

7. Impacts to the reproductive system including, but not limited to, sperm damage (e.g. reduced motility, structural anomalies), reduction in testosterone, ovarian health, organ development, and erectile dysfunction;[158]

8. Genetic damage including, but not limited to, DNA strand breaks, micronucleus formation, chromosomal structural changes, and epigenetic alterations;[159]

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[151] *See* Attachment 8.
[152] *See* Attachment 9.
[153] *See* Attachment 10.
[154] *See* Attachment 11.
[155] *See* Attachment 12.
[156] *See* Attachment 14.
[157] In 1999, the Architectural and Transportation Barriers Compliance Board (Access Board) issued a proposed rule to revise and update its accessibility guidelines for buildings and facilities subject to the ADA. During the six-month public comment period on the proposed rule, about 600 of the more than 2,500 comments submitted to the Access Board were written by individuals with multiple chemical sensitivities ("MCS") and electromagnetic sensitivities. The individuals reported, among other things, that chemicals released from products and materials used for construction and exposure to electromagnetic fields in buildings denied them access to most places. Commenters requested that the Board include provisions in its final rule to make indoor environments accessible to them. Neither the proposed rule nor the draft final rule included provisions for those who have MCS or electromagnetic sensitivities. Despite this, the Board recognized that "*multiple chemical sensitivities and electromagnetic sensitivities may be considered disabilities under the ADA if they so severely impair the neurological, respiratory, or other functions of an individual that it substantially limits one or more of the individual's major life activities. The Board plans to closely examine the needs of this population, and undertake activities that address accessibility issues for these individuals."* (Emphasis added.) *See* Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities, 69 Fed. Reg. 44,084 (July 23, 2004).
[158] *See* Attachment 14.
[159] *See* Attachment 15.

9. Impacts to the endocrine system including, but not limited to, thyroid function, adrenal hormones, glucose homeostasis, and melatonin levels;[160]

10. Impacts to the cardiovascular system including, but not limited to, heart rate variability, blood pressure, altered cardiac development, and hematologic function and parameters;[161]

11. Immune system deregulation, allergic and inflammatory responses;[162]

12. Prenatal impacts including, but not limited to, effects to the fetus, pregnancy (e.g., miscarriage and preterm birth), and/or the newborn child (e.g., birth weight, motor development, etc.);[163]

13. Synergistic effects resulting from exposure to multiple RF radiation frequencies, particularly when combined with ionizing radiation and/or other known carcinogens, chemicals, environmental pollutants, and other toxic agents;[164]

14. Auditory and aural impacts;[165] and

15. Ocular and ophthalmologic impacts.[166, 167]

For each of the foregoing, the Commission must justify the scientific and methodological approaches used to assess the totality of the extant scientific evidence.

[160] *See* Attachment 16.
[161] *See* Attachment 18.
[162] *See* Attachment 19.
[163] *See* Attachments 4 and 5.
[164] *See* Attachment 7.
[165] *See* Attachment 20.
[166] In 1992, research on monkeys found that low-level microwaves induced significant impacts on the eye. At 10 mW/cm,^{2} the researchers observed corneal endothelial lesions, increased iris vascular permeability, and degenerative changes in the cells of the iris and the retina. They conclude that, "*[t]he experiments reported herein demonstrate that exposure to relatively low levels of microwave radiation can result in significant ocular changes in the nonhuman primate. These changes range from cellular disruption to altered visual function,*" (Emphasis added). By comparison, the Commission's maximum permissible occupational RF radiation exposure limit is 5 mW/cm^2. Henry A. Kues & John C. Monahan, *Microwave-Induced Changes to the Primate Eye*, 13(1) Johns Hopkins APL Tech. Dig. 244, 253 (1992), https://secwww.jhuapl.edu/techdigest/content/techdigest/pdf/V13-N01/13-01-Kues.pdf.
[167] Saeed Shokoohi-Rad et al., *Comparison of Intraocular Pressure Changes Due to Exposure to Mobile Phone Electromagnetics Radiations in Normal and Glaucoma Eye*, 27(1) Middle East African J. Ophthalmology 10 (2020), https://doi.org/10.4103/meajo.MEAJO_20_19.

4. The Commission Must Address How Its 1996 RF Radiation Exposure Limits Address the Ubiquity of Wireless Devices Today.

a. Background.

Since 1996 the amount, types, and uses of RF radiation have exponentially grown in every age group from infancy to adult, as well as during pregnancy and in every setting from homes to workplaces to schools. The prevalence of wireless devices in our daily lives today is almost unimaginable compared to 29 years ago. Back in 1996 there were approximately 24,800 cell towers in the United States.[168] According to the 2021 "Annual Survey" report published by the Cellular Telecommunications and Internet Association ("CTIA"), by the end of 2020, that number skyrocketed to over 417,000 cell sites.[169] In its "2024 Annual Survey Highlights," CTIA reports that, as of 2023, there were 432,469 cell sites and 558,000,000 wireless connections in the United States.[170] One recent report states that the expected global number of connected devices, the IoT, will grow to 29.7 billion active endpoints by 2027.[171]

b. Description Of Significant Record Deficiencies and Updated Post-Record Evidence.

The Commission has failed to confront the omnipresent nature of RF radiation exposure today, ignoring dramatically rising levels from myriad sources that impact individuals of all ages across virtually every setting. Studies have found that environmental RF radiation levels have

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[168] Katie Dean, *Cell Towers Take Root on Farms*, WIRED (Jan. 10, 2000), https://www.wired.com/2000/01/cell-towers-take-root-on-farms/.
[169] *2021 Annual Survey HIGHLIGHTS*, CTIA (July 2021), https://api.ctia.org/wp-content/uploads/2021/07/CTIA-2021-Annual-Survey-Highlights_0727Update.pdf.
[170] *2024 Annual Survey Highlights*, CTIA (Sept. 10, 2024), https://www.ctia.org/news/2024-annual-survey-highlights.
[171] *See* Anand Taparia et al., *State of IoT – 2023*, IoT Analytics (May 24, 2023), https://iot-analytics.com/wp-content/uploads/2023/05/Insights-Release-State-of-IoT-2023-Number-of-connected-IoT-devices-growing-16-to-16.0-billion-globally.pdf. *See also* Satyajit Sinha, *State of IoT 2024: Number of connected IoT devices growing 13% to 18.8 billion globally*, IoT Analytics (Sept. 3, 2024), https://iot-analytics.com/number-connected-iot-devices/#:~:text=The%20latest%20IoT%20Analytics%20%E2%80%9CState,to%2016.7%20billion%20active%20endpoints.

significantly increased in recent years, with higher levels recorded in urban areas and in close proximity to wireless network transmitters (particularly in locations within the main transmission beams of the antenna(s)).[172] For example, a 2018 multi-country study[173] revealed that ambient RF radiation measurements in Los Angeles, California have surged to 70 times the levels recorded by the EPA beginning in October of 1975.[174]

However, the Commission does not maintain a national registry for all cell towers and wireless network antennas. Thus, the true extent and location of all RF radiation sources is unknown. When wireless operators, wireless facility site developers, tower operators, RF radiation engineering firms, or any other party responsible for wireless telecommunications infrastructure deployment performs computer simulations to demonstrate "compliance" with the Commission's current RF radiation exposure limits, such calculations can be misleading as they do not necessarily consider aggregate RF radiation emissions from all nearby transmitting wireless facilities. Further, no consideration is given to the fact that an individual may be using, or in the vicinity of, numerous personal wireless devices, while simultaneously exposed to RF radiation emissions generated by a nearby wireless facility. According to a survey of 8,000 U.S. internet households, "the average U.S. household with internet access had 17 connected devices in 2023."[175] Boussad et al. (2022) reported on the RF radiation produced by cellular antennas, Wi-Fi access points, and Bluetooth devices for 254,410 unique users in 13 countries between

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[172] *See* Attachment 21.

[173] Sanjay Sagar et al., *Comparison of radiofrequency electromagnetic field exposure levels in different everyday microenvironments in an international context*, 114 Env't Int'l 297 (2018), https://doi.org/10.1016/j.envint.2018.02.036.

[174] Norbert N. Hankin, *The Radiofrequency Radiation Environment: Environmental Exposure Levels and RF Radiation Emitting Sources* (1985), https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=2000ECTQ.PDF.

[175] Park Assocs., *Parks: Average U.S. Internet Home Had 17 Connected Devices in 2023* (Jan. 10, 2024), https://www.parksassociates.com/blogs/in-the-news/parks-average-us-internet-home-had-17-connected-devices-in-2023.

January 2017 and December 2020.[176] He found total exposure multiplied by 2.3 times during the four-year study period, with exposures at home from personal Wi-Fi routers and Bluetooth devices contributing to more than 50% of the total exposure for half of the study subjects. [177]

c. Suggested Approaches to Comply with the Remand and Address the Subject Impacts.

The Court's directive to address "the ubiquity of wireless devices" requires the Commission to evaluate RF radiation emissions, exposures, and safety in a comprehensive manner by considering the aggregate impacts of all devices and sources of RF radiation, rather than assessing each device in isolation. As such, the Commission should:

1. Review or solicit interagency assessments and reviews of increased real-world RF radiation exposures. This should include sources such as cell phones, cell towers, Wi-Fi networks, Bluetooth devices, "smart" meters, "smart" appliances, wireless telecommunications transmitters, and picocells, among others.

2. Review or commission independent scientific research on the biological effects of simultaneous exposure to multiple RF radiation frequencies. Such studies are essential to understand the health implications of cumulative RF radiation exposure commonly found in real-world environments.

3. Review or commission scientific research on RF radiation exposure levels and health outcomes across various environments, including homes, schools, and workplaces.

4. Mandate that RF radiation compliance testing methodologies for RF radiation-emitting devices, both licensed and unlicensed, account for total real-world exposure from multiple sources.

5. Collect or commission and analyze epidemiological data on real-world RF radiation exposure scenarios.[178]

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[176] Yanis Boussad et al., *Longitudinal study of exposure to radio frequencies at population scale*, 162 Env't Int'l 107144 (2022), https://doi.org/10.1016/j.envint.2022.107144.
[177] Id.
[178] *See* Dimitris J. Panagapoulos et al., *A comprehensive mechanism of biological and health effects of anthropogenic extremely low frequency and wireless communication electromagnetic fields*, 13 Frontiers Pub.

6. Commission animal studies conducted by the appropriate federal agencies and/or by independent researchers that reflect real-world RF radiation exposure scenarios. For example, studies should simulate environments with simultaneous exposure from different wireless devices and wireless infrastructure as commonly found in homes, offices, and schools.

7. Address widespread occupational exposure by updating RF radiation occupational exposure limits and the regulatory framework for such limits. Current RF radiation limits must reflect the evolving landscape of workplace RF radiation exposures, particularly for individuals with prolonged or elevated exposure (e.g., Transportation Security Administration ("TSA") officers who operate mm-wave body scanners).

d. Additional Measures the Commission Must Undertake to Fulfill Its Congressionally-Mandated Obligation to Set RF Radiation Exposure Limits That Adequately Protect the Public Given Today's Changed Technological Landscape.

Many modern occupations now subject workers to routine, cumulative exposure to diverse sources of RF radiation.[179] Despite this, most U.S. occupational safety or public health authorities do not actively monitor RF radiation exposures or gather health surveillance data related to the workplace. Due to the absence of this important data, the U.S. National Institute for Occupational Safety and Health ("NIOSH")[180] and OSHA are often unable to equip employers with the most relevant information on methods for mitigating RF radiation exposures in the workplace. Of particular concern is the protection of vulnerable populations (e.g., pregnant women). As such, the Commission, in consultation with OSHA and NIOSH, must develop revised limits for occupational exposures, including mandatory oversight and monitoring for specific occupations, such as TSA officers, to ensure worker safety from RF radiation.[181] The

Health 1585441 (2025), https://doi.org/10.3389/fpubh.2025.1585441. *See also* Dimitris J. Panagopoulos ed., *Electromagnetic Fields of Wireless Communications: Biological and Health Effects* (2022).

[179] *See* Attachment 25.

[180] "NIOSH has, in the past, undertaken to develop RF exposure guidelines for workers, but final guidelines were never adopted by the agency." *See RF Safety FAQ*, FCC https://www.fcc.gov/engineering-technology/electromagnetic-compatibility-division/radio-frequency-safety/faq/rf-safety (last visited, July 22, 2025).

[181] According to Robert A. Curtis, the former Director of the U.S. DOL/OSHA Health Response team, the following outlines the principal elements of an "RF Protection Program" for workers: 1) Utilization of RF source equipment

Commission must also work with the appropriate government agencies to review all types of job-related tasks that might expose workers to heightened RF radiation risks to ensure worker protections are complete, effective, and based on the latest scientific research. Finally, the Commission must justify the cumulative health risks and medically explain why occupational RF radiation exposure limits currently allow workers—even if they are "trained"—to be exposed to more RF radiation than members of the public.[182]

4. The Commission Must Address Technological Developments Since It Last Updated RF Radiation Exposure Limits 29 Years Ago.

a. Background.

Since the Commission last revised its RF radiation limits in 1996, the technological landscape has experienced radical transformations. Yet, the Commission's current RF radiation limits, and its underlying regulatory framework, have remained static. Telecommunications networks today operate at significantly higher carrier frequencies, utilize novel modulation and pulsation techniques, and at certain continually densified facilities (i.e., more heavily loaded towers and rooftops) transmit cumulative signals with higher power outputs per facility.

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which meet applicable RF and other safety standards when new and during the time of use, including after any modifications, 2) RF hazard identification and periodic surveillance by a competent person who can effectively assess RF exposures, 3) Identification and control of RF hazard areas, 4) Implementation of controls to reduce RF exposures to levels in compliance with applicable guidelines, including the establishment of safe work practice procedures, 5) RF safety and health training to ensure that all employees understand the RF hazards to which they may be exposed and the means by which the hazards are controlled, 6) Employee involvement in the structure and operation of the program and in decisions that affect their safety and health, to make full use of their insight and to encourage their understanding and commitment to the safe work practices established, 7) Implementation of an appropriate medical surveillance program, 8) Periodic (e.g., annual) reviews of the effectiveness of the program so that deficiencies can be identified and resolved, and 9) Assignment of responsibilities, including the necessary authority and resources to implement and enforce all aspects of the RF protection program. *See* Presentation by Robert A. Curtis, former Dir., US Dep't of Labor/OSHA Health Response Team to Nat'l Assoc. of Broadcasters, Broadcast Eng'g Conf., Las Vegas, NV, Apr. 12, 1995, https://www.osha.gov/radiofrequency-and-microwave-radiation/role-of-rf-measurements.

[182] Peter Jeschke et al., *Protection of Workers Exposed to Radiofrequency Electromagnetic Fields: A Perspective on Open Questions in the Context of the New ICNIRP 2020 Guidelines*, 10 Frontiers Pub. Health 875946 (2022), https://doi.org/10.3389/fpubh.2022.875946.

Emerging technologies use signaling characteristics—including complex phasing, beam steering,[183] and Massive MIMO[184]—and employ frequency ranges (submillimeter and millimeter waves) that have never been used before in broad civilian-based communications networks. Additionally, both terrestrial and satellite-based networks operate on a far wider variety of RF radiation frequencies compared to 29 years ago, including low-, mid-, and high-band frequencies (e.g., 12 GHz to 18 GHz, 28 GHz, 60 GHz, and 70 GHz).[185]

Additionally, wireless transmitting facilities are now being installed closer to people than ever before, leading to increased ambient levels of RF radiation exposure.[186] Base station antennas were previously sited thousands of feet—or even miles—away from homes, schools, and workplaces. However, the telecommunications industry's aggressive push to densify its wireless networks has resulted in "small cell" antennas and high-powered wireless transmitters mounted on utility poles, streetlights, and atop residential buildings—sometimes mere feet from bedroom windows. This proximity raises serious public health and public safety concerns[187] that merit closer scrutiny by the Commission.

RFIAWG recognized the serious deficiencies with the Commission's RF radiation exposure limits, especially as they relate to modulation, exposure duration, intensity, time averaging, and peak exposures:

[183] "Beam steering" refers to RF radiation signals that are directionally focused and dynamically aimed using a technique called "beamforming." This results in directional beams with a higher concentration of electromagnetic energy which can lead to more intense exposure to certain human tissues, such as the skin and eyes.
[184] "Massive MIMO" stands for massive multiple-input multiple-output. This is a type of wireless communications technology in which base stations are equipped with many antenna elements to improve spectral density.
[185] "SpaceX is now also permitted to communicate between 71 and 76 gigahertz from space to Earth, and 81-86 GHz Earth-to-space." Jason Rainbow, *SpaceX gets E-band radio waves to boost Starlink broadband*, SpaceNews (Mar. 11, 2024), https://spacenews.com/spacex-gets-e-band-radio-waves-to-boost-starlink-broadband/.
[186] *See* Attachment 21.
[187] Public safety concerns include electrical fires, cell tower collapse (particularly during severe storm events), and falling ice/snow from cell tower equipment in colder regions.

> In 1999, the RFIAWG identified 14 significant issues with RFR limits, highlighting the lack of consideration of modulation and the use of averaging: Studies continue to be published describing biological responses to nonthermal ELF-modulated and pulse-modulated RF radiation exposures that are not produced by CW [continuous wave] (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 continuous wave 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?[188]

Research indicates that individual parameters of communication signals can have distinct biological effects.[189] For example, different forms of signal modulation can trigger different biological impacts even at the same frequency and incident power density.[190] Intermittent exposure to RF radiation can trigger different biological effects than continuous exposure.[191]

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[188] Letter from W. Gregory Lotz, *supra* note 149.

[189] Igor Y. Belyaev, *Main Regularities and Health Risks from Exposure to Non-Thermal Microwaves of Mobile Communication*, 2019 14th Int'l Conf. on Advanced Techs., Systems & Servs. Telecomms. (TELSIKS) 111 (2019), https://doi.org/10.1109/TELSIKS46999.2019.9002324; B. Blake Levitt et al., *Effects of non-ionizing electromagnetic fields on flora and fauna, Part 2 impacts: how species interact with natural and man-made EMF*, 37(3) Revs. on Env't Health 327 (2022), https://doi.org/10.1515/reveh-2021-0050; B. Blake Levitt et al., *Effects of non-ionizing electromagnetic fields on flora and fauna, Part 3. Exposure standards, public policy, laws, and future directions*, 37(4) Revs. on Env't Health 531 (2022), https://doi.org/10.1515/reveh-2021-0083.

[190] Igor Y. Belyaev, *Dependence of non-thermal biological effects of microwaves on physical and biological variables: Implications for reproducibility and safety standards*, 5 Eur. J. Oncology Libr. 187 (2010), https://www.researchgate.net/publication/284970330_Dependence_of_non-thermal_biological_effects_of_microwaves_on_physical_and_biological_variables_Implications_for_reproducibility_and_safety_standards; Igor Y. Belyaev & Yu G. Grigoriev, *Problems in assessment of risks from exposures to microwaves of mobile communication*, 47(6) Radiatsionnaia biologiia, radioecologiia 727 (2007), https://www.researchgate.net/publication/5473000_Problems_in_assessment_of_risks_from_exposures_to_microwaves_of_mobile_communication; Henry Lai & B. Blake Levitt, *supra* note 73; Dimitris J. Panagopoulos et al., *Polarization: A Key Difference between Man-made and Natural Electromagnetic Fields, in regard to Biological Activity*, 5 Sci. Reps. 14914 (2015), https://doi.org/10.1038/srep14914.

[191] Igor Y. Belyaev, *supra* note 189.

Modulated microwaves can precipitate different biological responses compared to continuous wave microwave exposure.[192, 193] In essence, real mobile phone emissions are constantly and unpredictably varying, and this variability is an important parameter related to biological impacts.[194]

The Commission's current RF radiation exposure limits and compliance testing methodologies fail to consider all relevant RF radiation parameters that impact human health and the environment. Instead, only one parameter is considered—the thermal effect of RF radiation exposure based on the Commission's parochial SAR threshold. Measurement procedures use time-averaging and tissue-averaging, both of which mask the peak intensities from pulsations and peak intensities for sensitive bodily tissues.[195] Time-averaging also erases the unique characteristics of intensity-modulated RF radiation which may be responsible for triggering adverse biological effects.

A striking example of the impact of RF radiation pulsations is illustrated in a 2021 U.S. Army and Air Force Research Laboratory which found that high-powered, pulsed RF radiation exposures at levels within the Commission's current RF radiation exposure limits could generate

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[192] "There is strong experimental evidence for the role of modulation in the diverse biological effects of NT [non-thermal] MW [microwaves] both *in vitro* and *in vivo*." Igor Y. Belyaev, *supra* note 190 at 194. *See also* Attachment 23.

[193] Retrospective analysis of 52 Russian/Soviet in vivo studies with animals (mice, rats, rabbits, guinea pigs) on chronic exposure to RF radiation has recently been published…Based on the analysis, the authors conclude that "Exposure to modulated MW resulted in bioeffects, which can be different from the bioeffects induced by CW MW; exposure to modulated MW at low intensities (non-thermal levels) could result in development of unfavorable effects; direction and amplitude of the biological response to non-thermal MW, both *in vitro* and *in vivo*, depended on type of modulation; often, but not always, modulated MW resulted in more pronounced bioeffects than CW MW; the role of modulation was more pronounced at lower intensity levels." Igor Y. Belyaev, *supra* note 190 at 196.

[194] Dimitris J. Panagopoulos et al., *Real versus Simulated Mobile Phone Exposures in Experimental Studies*, 2015 BioMed Research Int'l 607053 (2015), https://doi.org/10.1155/2015/607053.

[195] "Measurement protocols must identify the specific frequencies of each of the currently established major frequency bands, the temporal behavior of the signal and the power density. Measurement systems must not only determine averaged field strengths but must be able to measure the peak amplitude over time and, consequently, the cumulative radiation. This would make the characterization of EMFs much more realistic." Isabel López et al., *It is mandatory to review environmental radiofrequency electromagnetic field measurement protocols and exposure regulations: An opinion article*, 10 Frontiers Pub. Health 992645 (2022), https://doi.org/10.3389/fpubh.2022.992645.

brain pressure levels comparable to those caused by explosive blasts or football-related head injuries.[196] Decades of research have documented the existence of nonlinear effects, frequency and power density "windows" (in which biological effects disappear depending on different values of the same parameter) even at levels considerably lower than the Commission's current RF radiation exposure limits.[197] The Commission's limits omit consideration of these critical, complex realities. Thus, the scientific literature amply supports and reinforces the notion that the Commission's short-term, thermal-based limits are inadequate to protect human health and the environmental amidst today's technological developments.[198]

b. Description Of Significant Record Deficiencies and Updated Post-Decision Evidence.

The Commission's *2019 Order* disregards decades of scientific evidence submitted to the record and fails to consider advances in wireless technology and health research since the adoption of RF radiation exposure limits. Post-decision evidence[199] continues to document that

[196] "…the simulations here have shown that exceptionally intense HPM exposures with incident power densities greater than 1.5 × 106 mW/cm^2 (at short pulse durations) may generate intracranial stresses that are similar (±∼20 to 200 kPa) in comparison to typical TBI events (sports, vehicle accidents, ballistic impact, etc.). For sufficiently short microwave pulse durations (<τc), large tensile stresses are created in the deep regions of the brain…While the peak power densities used within this simulation study are large, they are achievable with known microwave hardware. For example, to produce a power density of 1 × 10^6 mW/cm^2 at 25 m away from a 40-dBi antenna, a microwave source would require approximately 8 MW of power per pulse. This is within the capabilities of some commercial and military systems, and we therefore consider this as a relevant approximation for the simulations here." Amy M. Dagro et al., *Computational modeling investigation of pulsed high peak power microwaves and the potential for traumatic brain injury*, 7(44) Sci. Advances abd8405 (2021), https://doi.org/10.1126/sciadv.abd8405. *See also* James C. Lin, *A Paradigm Shift?*, 24(12) IEEE Microwave Mag. 16 (2023), https://doi.org/10.1109/MMM.2023.3313788.

[197] Isabel López et al., *supra* note 195; Frank Barnes & Eugene R. Freeman, Jr., *supra* note 139; Henry Lai & B. Blake Levitt, *supra* note 73.

[198] *See* Igor Y. Belyaev *supra* note 190 at 196; Frank Barnes & Eugene R. Freeman, Jr., *supra* note 139; Lennart Hardell & Cindy Sage, *Biological effects from electromagnetic field exposure and public exposure standards*, 62(2) Biomedicine & Pharmacotherapy 104 (2008), https://doi.org/10.1016/j.biopha.2007.12.004.

[199] Isabel López et al., *supra* note 195; Frank Barnes & Eugene R. Freeman, Jr., *supra* note 139.

"current RFR exposure guidelines based on acute continuous-wave exposure are inadequate for health protection."[200]

c. Recommended Approaches to Comply With the Remand and Address the Subject Impacts.

1. Rigorous, Up-To-Date Review of Emerging RF Radiation Exposure Parameters. Given the increasing complexity of RF radiation emissions, including but not limited to, higher frequencies,[201] novel modulations, and advanced new antenna systems,[202] the Commission must undertake a rigorous, up-to-date review of scientific studies addressing these evolving exposure characteristics and their linear and non-linear biological effects.[203] The Commission must then provide clear, evidence-based rationale for its exclusion of parameters from current RF radiation exposure limits and hazard assessments or initiate a rulemaking to revise the limits accordingly.

2. Address Proximity of Emitting Facilities and Devices in RF Radiation Exposure Analysis. Analyses must account for the fact that RF radiation-emitting technologies are now used and deployed in much closer proximity to people than they were in 1996.

[200] "Research data indicate that electromagnetic energy is more biologically potent in causing effects than thermal changes. The two likely function through different mechanisms. As such, any current RFR exposure guidelines based on acute continuous-wave exposure are inadequate for health protection." Henry Lai & B. Blake Levitt, *supra* note 73.
[201] *See* Attachment 22.
[202] For example, when the world's first flip phone, the Motorola StarTAC, was introduced in 1996 it transmitted on only one frequency and was later upgraded to two frequencies. Motorola StarTAC 80*, Mobile Phone Museum*, https://www.mobilephonemuseum.com/phone-detail/startac-80 (last visited July 13, 2025). The iPhone 15 Pro, released in 2023, transmits on 61 frequencies. iPhone - Cellular Technology, *Apple*, https://www.apple.com/iphone/cellular/ (last visited July 13, 2025).
[203] "Measurement protocols must identify the specific frequencies of each of the currently established major frequency bands, the temporal behavior of the signal and the power density. Measurement systems must not only determine averaged field strengths but must be able to measure the peak amplitude over time and, consequently, the cumulative radiation. This would make the characterization of EMFs much more realistic.…Choosing intensity as the only determining parameter for the occurrence of effects is a reductionist conception. The consideration of all EMFs parameters in the assessment of biological response should be mandatory." Isabel López et al., *supra* note 195 at 3.

5. The Commission Must Address the Environmental Impacts of RF Radiation.

a. Background.

The Commission's RF radiation limits were developed exclusively to protect humans, leaving flora and fauna unaccounted for. Buildouts of new wireless telecommunications facilities are rapidly increasing RF radiation exposure levels in wildlife habitat. As Levitt et al. (2021) states:

> "Wildlife loss is often unseen and undocumented until tipping points are reached. A robust dialog regarding technology's high-impact role in the nascent field of electroecology needs to commence."[204]

The National Environmental Policy Act ("NEPA"),[205] enacted by Congress in 1969, created a government-wide mandate to incorporate environmental values into decision-making. The Commission, as a federal agency, is subject to NEPA. While the Commission may not be required to conduct an "Environmental Impact Statement" or "Environmental Assessment" in every proceeding, it does have a responsibility to consider environmental impacts when its actions (such as authorizing the unprecedented licensing, launch, and deployment of satellite mega-constellations[206] and licensing the electromagnetic spectrum for commercial and non-commercial use) may have environmental consequences. Notably, most 5G phones are capable

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[204] B. Blake Levitt et al., *Effects of non-ionizing electromagnetic fields on flora and fauna, Part 3. Exposure standards, public policy, laws, and future directions*, *supra* note 189 at 531.

[205] 42 U.S.C. § 4321 et seq.

[206] A report from the U.S. GAO in November 2022 emphasized the need for Environmental Impact Assessments regarding satellite mega constellations—which have heretofore been missing. *See* U.S. Gov't. Accountability Off., *Satellite Licensing: FCC Should Reexamine Its Environmental Review Process for Large Constellations of Satellites*, GAO-23-105005 (Nov. 2022). https://www.gao.gov/assets/gao-23-105005.pdf. *See also Opposition to SpaceX Application for Major Modification; and Motion for Consultation with Affected Agencies; Motion for Disclosure; Motion for Certification of Indemnity and Motion to Suspend or Revoke Licenses*, In the matter of SpaceX Services Corporation, Application for Major Modification, SAT-MOD-20200417-00037 (FCC, May 26, 2020). https://www.thebalancegroup.net/uploads/7/0/4/2/7042138/attachment_1_balance_group_opposition_and_motions_to_spacex_application_for_major_modification_v_final_may_27_2020__1_.pdf. *See also* Scott Millwood *supra* note 7.

of connection to satellite networks.[207] NEPA defines the term "effects" broadly to include ecological, aesthetic, historic, cultural, economic, social, or health (whether direct, indirect, or cumulative).[208]

b. Description of Significant Record Deficiencies and Updated Post-Decision Evidence.

The Commission was found to have, as the Court put it, "completely" ignored environmental impacts in its decision to retain 1996 RF radiation exposure limits.[209] Many studies supplied to the Commission for evaluation and consideration have concluded that RF radiation can precipitate a broad range of adverse effects on flora and fauna. For example, a 2023 systematic review and meta-analysis of scientific studies on the biological effects of non-ionizing electromagnetic fields on insects concludes that the "vast majority of studies found effects, generally harmful ones" with toxic effects such as impacts to reproduction and immune health occurring at legally allowed exposure levels. [210] A 2021 three-part research review of over 1,200 studies on effects to wildlife published in *Reviews on Environmental Health* concludes that the current state of the science should trigger urgent regulatory action.[211] A 2015 scientific literature review warned that non-ionizing EMFs are an "emerging threat" to wildlife,[212] and a 2013

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[207] *See generally* Nicole Lee, *Here's Everything You Need to Know About Satellite Connectivity in Phones*, CNET (July 15, 2025), https://www.cnet.com/tech/mobile/heres-everything-you-need-to-know-about-satellite-connectivity-in-phones/.
[208] 40 C.F.R. § 1508.1(i).
[209] EHT v. FCC, 9 F.4th at 909.
[210] Alain Thill et al., *Biological effects of electromagnetic fields on insects: a systematic review and meta-analysis*, 39(4) Revs. on Env't Health 853 (2024), https://doi.org/10.1515/reveh-2023-0072.
[211] B. Blake Levitt et al., *Effects of non-ionizing electromagnetic fields on flora and fauna, part 1. Rising ambient EMF levels in the environment*, 37(1) Revs. on Env't Health 81 (2022), https://doi.org/10.1515/reveh-2021-0026; B. Blake Levitt et al., *Effects of non-ionizing electromagnetic fields on flora and fauna, Part 2 impacts: how species interact with natural and man-made EMF*, *supra* note 189; B. Blake Levitt et al., *Effects of non-ionizing electromagnetic fields on flora and fauna, Part 3. Exposure standards, public policy, laws, and future directions*, *supra* note 189.
[212] "Current evidence indicates that exposure at levels that are found in the environment (in urban areas and near base stations) may particularly alter the receptor organs to orient in the magnetic field of the earth. These results

scientific review, which examined 113 studies, found that RF radiation has a significant effect on birds, insects, vertebrates, other organisms, and plants in 70% of studies.[213]

The Commission previously disregarded a critically important letter submitted by the DOI to the Commission back in 2014 regarding the effects of RF radiation on birds. The letter states: "Radiation studies at cellular communication towers were begun circa 2000 in Europe and continue today on wild nesting birds. Study results have document nest and site abandonment, plumage deterioration, locomotion problems, reduced survivorship, and death."[214] The letter also states: "…the electromagnetic radiation standards used by the Federal Communications Commission (FCC) continue to be based on thermal heating, a criterion now nearly 30 years out of date and inapplicable today."[215] Finally, DOI concluded that "third-party peer-reviewed studies need to be conducted in the U.S. to begin examining the effects from radiation on migratory birds and other trust species."[216, 217]

Dr. Albert Manville, former senior biologist for the U.S. Fish and Wildlife Service and agency lead on avian-structural impacts (including from radiation), authored "*A BRIEFING MEMORANDUM: What We Know, Can Infer, and Don't Yet Know about Impacts from Thermal*

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could have important implications for migratory birds and insects, especially in urban areas, but could also apply to birds and insects in natural and protected areas where there are powerful base station emitters of radiofrequencies…more research on the effects of electromagnetic radiation in nature is needed to investigate this emerging threat." Alfonso Balmori, *Anthropogenic radiofrequency electromagnetic fields as an emerging threat to wildlife orientation*, 518-19 Sci. Total Env't 58 (2015), https://doi.org/10.1016/j.scitotenv.2015.02.077.

[213] S. Cucurachi et al., *A review of the ecological effects of radiofrequency electromagnetic fields (RF-EMF)*, 51 Env't Int'l 116 (2013), https://doi.org/10.1016/j.envint.2012.10.009.

[214] Letter from Willie R. Taylor, Director, Off. of Env't Policy & Compliance, U.S. Dep't of the Interior, to Eli Veenendaal, Nat'l Telecomms. & Info. Admin., U.S. Dep't of Com. (Feb. 7, 2014), https://ehtrust.org/wp-content/uploads/Department-of-Interior-Feb-2014-letter-on-Birds-and-RF.pdf.

[215] Id. at 5.

[216] Id.

[217] The term "federal trust species" means migratory birds, threatened species, endangered species, interjurisdictional fish, marine mammals, and other species of concern. *See* 16 U.S.C. § 3772(1).

and Non-thermal Non-ionizing Radiation to Birds and Other Wildlife."[218] In this memorandum, Dr. Manville states: "The radiation effects on wildlife need to be addressed by the Federal Communications Commission (FCC), the Environmental Protection Agency (EPA), the Department of Commerce, the U.S. Fish and Wildlife Service (FWS) and other governmental entities."[219] This memorandum was submitted to the Commission for review and, once again, was ignored.

The Commission also received studies detailing the impacts of RF radiation on bees and other insects. Documented effects of RF radiation exposure on bees include, but are not limited to, inducing artificial worker piping,[220] disrupting navigation abilities,[221] reducing colony strength,[222] and physiological changes.[223] A 2025 study published in *Agriculture* investigated how 7 days of exposure to 900 MHz frequencies affect the behavior of honey bees in laboratory conditions.[224] The researchers emphasized that the behaviors selected for investigation (flight, walking, grooming, social contact, and immobility) "play critical roles in the maintenance of

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[218] Memorandum by Albert M. Manville, *A BRIEFING MEMORANDUM: What We Know, Can Infer, and Don't Yet Know about Impacts from Thermal and Non-thermal Non-ionizing Radiation to Birds and Other Wildlife*, EHT (July 14, 2016), https://ehtrust.org/wp-content/uploads/wildlife-RF-effects-Manville-7-14-2016-Briefing-Memo.pdf.
[219] Id. at 1.
[220] Daniel Favre, *Mobile phone-induced honeybee worker piping*, 42 Apidologie 270 (2011), https://doi.org/10.1007/s13592-011-0016-x. Bee "piping" refers to "pipers" or excited bees that scramble through the swarm cluster, pausing every second or so to emit a pipe. Each pipe consists of a sound pulse which lasts 0.82 +/- 0.43 seconds and rises in fundamental frequency from 100-200 Hz to 200-250 Hz. Many, if not all, of the pipers are nest-bounded scouts. A pipe transmits information to the hive. Thomas D. Seeley & Jürgen Tautz, *Worker piping in honey bee swarms and its role in preparing for liftoff*, 187(8) J. Compar. Physiology 667 (2001), https://doi.org/10.1007/s00359-001-0243-0.
[221] Stefan Kimmel et al., *Electromagnetic radiation: Influences on honeybees (Apis mellifera)*, IIAS-InterSymp Conf. 1 (2007), https://www.researchgate.net/publication/292405747_Electromagnetic_radiation_Influences_on_honeybees_Apis_mellifera_IIAS-InterSymp_Conference.
[222] Wolfgang Harst et al., *Can Electromagnetic Exposure Cause a Change in Behaviour? Studying Possible Non-Thermal Influences on Honey Bees – An Approach within the Framework of Educational Informatics*, VI(1) Acta Systematica - IIAS Int'l J. 1 (2006), https://bemri.org/publications/plants-and-wildlife/wildlife/100-can-emf-exposure-cause-a-change-in-behaviour-studying-possible-non-thermal-influences-on-bees/file.
[223] Arno Thielens et al., *Radio-Frequency Electromagnetic Field Exposure of Western Honey Bees*, 10 Sci. Reps. 461 (2020), https://doi.org/10.1038/s41598-019-56948-0.
[224] Pawel Migdal et al., *supra* note 70.

colony health and individual fitness."[225] After exposure, the walking, flight, and individual contact of the bees was significantly disrupted.[226] Balmori (2020) states: "Bees are highly sensitive to magnetic fields, especially for orientation and navigation…linked EMF exposure to the decline of certain insect species, citing studies which concluded loss of queen cells, changes to weight gain of hive, poor survival in winter, changes to propolisation, changes to flight, foraging and feeding, changes to short-term memory, reduced egg-laying speed of queen, no honey or pollen in a colony by the end of exposure, lower weight of honeycomb, increased mortality."[227] Another 2018 study found that insects (including the Western honeybee) can absorb 5G's higher RF radiation frequencies, resulting in absorbed power increases of up to 370%.[228] The researchers warn that these frequencies "could lead to changes in insect behavior, physiology, and morphology over time."[229]

Plants and trees are also harmed by RF radiation. A review of 45 peer-reviewed, scientific publications on impacts to plants concludes that, "…a substantial amount of the studies on RF-EMFs from mobile phones show physiological and/or morphological effects. Additionally, our analysis of the results from these reported studies demonstrates that the maize, roselle, pea, fenugreek, duckweeds, tomato, onions, and mungbean plants seem to be very sensitive to RF-EMFs."[230] A nine-year German field study of over 100 trees found significant

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[225] Id.
[226] Id.
[227] Alfonso Balmori, *Electromagnetic radiation as an emerging driver factor for the decline of insects*, 767 Sci. Total Env't 144913 (2021), https://doi.org/10.1016/j.scitotenv.2020.144913.
[228] Arno Thielens et al., *Exposure of Insects to Radio-Frequency Electromagnetic Fields from 2 to 120 GHz* 8 Sci. Reps. 3924 (Mar. 2, 2018), https://www.nature.com/articles/s41598-018-22271-3.
[229] Neelima R. Kumar et al., *Exposure to cell phone radiations produces biochemical changes in worker honey bees*, 18(1) Toxicology Int'l 70 (2011), https://pmc.ncbi.nlm.nih.gov/articles/PMC3052591/.
[230] Malka N. Halgamuge, *Review: Weak radiofrequency radiation exposure from mobile phone radiation on plants*, 36(2) Electromagnetic Biology & Med. 213 (2017), https://doi.org/10.1080/15368378.2016.1220389; Martin L. Pall, *Electromagnetic Fields Act Similarly in Plants as in Animals: Probable Activation of Calcium Channels via Their Voltage Sensor*, 10(1) Current Chem. Biology 74 (2016), http://dx.doi.org/10.2174/2212796810666160419160433.

damage to tree canopies near wireless transmitters.[231] A study on aspen seedings found ambient RF radiation in Colorado associated with necrotic lesions on the leaves, decreased leader length and leaf area, and suppressed fall anthocyanin production.[232] Researchers continue to document the adverse impacts of RF radiation on trees, all of which were submitted to the Commission for review in Docket 13-84.[233, 234, 235]

Post-decision studies on plants continue to corroborate decades of research findings, further highlighting the urgent need for action.[236] In line with numerous scientific appeals over the last two decades, a 2023 article by wildlife biologists and bioelectromagnetic experts concludes that current exposure limits are inadequate to protect wildlife and recommend RF radiation reduction measures be implemented to mitigate risk.[237]

c) Recommended Approaches to Comply with the Remand and Address the Subject Impacts.

To ensure environmental issues are adequately addressed by the Commission's RF radiation exposure limits, the Commission should:

[231] Cornelia Waldmann-Selsam et al., *Radiofrequency radiation injures trees around mobile phone base stations*, 572 Sci. Total Env't 554 (2016), https://doi.org/10.1016/j.scitotenv.2016.08.045.
[232] Katie Haggerty, *Adverse Influence of Radio Frequency Background on Trembling Aspen Seedlings: Preliminary Observations*, 2010 Int'l J. Forestry Rsch. 836278 (2010), https://doi.org/10.1155/2010/836278.
[233] *Trees in Bamberg and Hallstadt in the radiation field of 65 mobile phone base stations: Examples from a documentation about 700 trees (2006-2016)*, Kompetenzinitiative, https://kompetenzinitiative.com/wp-content/uploads/2019/08/Trees-in-Bamberg-and-Hallstadt-Documentation-2006-2016.pdf (last visited May 27, 2025).
[234] Helmut Breunig, *Tree damage caused by mobile phone base stations: An observation guide*, Kompetenzinitiave (Mar. 2017), https://kompetenzinitiative.com/wp-content/uploads/2019/08/2017_Observation_Guide_ENG_FINAL_RED.pdf.
[235] Cornelia Waldmann-Selsam, *Tree Damage Caused by Radiofrequency Radiation: Exemplary Observations from 2005 to 2021 in Germany*, EHT, https://ehtrust.org/wp-content/uploads/Tree-damage-by-radiofrequency-radiation-translated-from-German-1-1.pdf (last visited May 27, 2025).
[236] *See* Attachment 24.
[237] Jérémy S. P. Froidevaux et al., *Addressing Wildlife Exposure to Radiofrequency Electromagnetic Fields: Time for Action*, 11(1) Env't Sci. & Tech. Letters 3 (2024), https://pubs.acs.org/doi/10.1021/acs.estlett.3c00795.

1. Recognize scientific gaps in current regulations regarding both short- and long-term, non-thermal RF radiation exposure on flora and fauna.

2. Mandate a comprehensive, interdisciplinary scientific review of RF radiation impacts to flora and fauna. Solicit federal agencies and the international community (e.g., the United Nations Environmental Programme and International Union for Conservation of Nature) with relevant expertise to review the full body of scientific research regarding RF radiation impacts to flora and fauna. The review should include, but not be limited to, studies on impacts to reproduction, development, behavior, and multi-stressor effects (e.g., synergistic effects of RF radiation exposure and pesticides, and heavy metals). Duration, frequency, modulation, and other relevant technological parameters must be addressed in the review. Such a review could form the basis for evidence-based policies regarding RF radiation exposure of non-human organisms.

3. Establish science-based RF radiation exposure limits for flora and fauna. Solicit federal agencies and the international community to develop science-based RF radiation exposure limits for flora and fauna that adequately protect against adverse effects of both short- and long-term, non-thermal effects of RF radiation exposure.

4. Review the adequacy of existing RF radiation compliance measurement protocols in accounting for wildlife behavior and habitat. For example, birds often nest atop cell towers or on tree limbs near the main beams of transmitting wireless facilities. Current compliance tests only consider areas where humans are present.

5. Establish a comprehensive national program to monitor, analyze, and publicly report RF radiation exposure, with a focus on ecologically sensitive areas.

    a) Continuously collect and analyze RF radiation exposure data across the United States, “ecologically sensitive areas” as identified by EPA, USGS, DOI, BLM, NMFS, USFWS, and the USACE.

    b) Make RF radiation data publicly accessible through an open data platform to support transparency, public awareness, and independent research.

    c) Implement environmental surveillance and reporting mechanisms to assess RF radiation effects on flora and fauna, particularly in areas where new commercially available RF radiation frequencies are deployed.

d) Require both short- and long-term monitoring of non-thermal biological impacts on flora and fauna, with an emphasis on endangered species and pollinators.

e) Direct federal agencies with relevant expertise to engage in ongoing research activities (e.g. field studies on bioeffects to wildlife, particularly endangered species and pollinators).

6. Mandate wireless telecommunications companies and wireless telecommunications site developers abide by USFWS "Best Practices for Communication Tower Design, Siting, Construction, Operation, Maintenance, and Decommissioning;"[238]

7. Develop and strengthen policies, and publish compliance reports and real-time RF exposure levels, so that the public can be assured there is effective oversight and enforcement of modern and sensible RF radiation exposure limits in the ambient environment, including in cities, suburbs, rural areas, and wilderness areas.

8. Conduct comprehensive environmental reviews (akin to, but not limited to, environmental impact statements) prior to the licensing and national buildout of major new RF radiation frequencies like those used for 6G systems, dynamic spectrum sharing, spectrum densification, network slicing, new frequency modulations, and beyond.

9. Develop educational material for property owners, renters, and the general public, as well as states and localities, on telecommunications, environment, and the law as to what is a safe human RF exposure limit for base stations and what is a safe SAR for wireless devices.

10. Publish regular reports as to whether human-generated polarized waveforms have been professionally measured as to their impact on flora and fauna. Utilize an ecosystem approach that considers the interdependent, interconnected relationships of microbiota, plants, and animals. Conduct NEPA reviews and Endangered Species Act reviews that take into account this information.

11. As developing adequate regulations for the environment will take time, the FCC should take immediate action to mitigate current RF radiation levels, particularly in ecologically sensitive areas. Relevant federal agencies should be tasked with developing a list of RF

[238] USFWS Migratory Bird Program, *Recommended Best Practices for Communication Tower Design, Siting, Construction, Operation, Maintenance, and Decommissioning* (Mar. 2021), https://www.fws.gov/sites/default/files/documents/usfws-communication-tower-guidance.pdf.

radiation mitigation measures. For example, wildlife experts recommend:[239]

i. Implementing guiding principles of radiation safety based on human radiation safety standards "As Low as Reasonably Achievable" (ALARA) or the minimum power necessary, whichever is lower.

ii. Create low and no-EMF zones, especially in ecologically sensitive areas as identified by the USFWS, United States Geological Survey, United States Army Corps of Engineers, and the EPA.

iii. Require strategic design modifications to reduce EMF emissions in wildlife conservation areas—for example, positioning transmitters to emit away from foraging and nesting sites. Conduct an NOI to request information from the public on how to best accomplish this.

iv. Maximize the distance between wildlife and RF radiation-emitting infrastructure with barriers (i.e., netting), predatory decoys, or other measures.

v. Require public hearings and publish environmental impact reports prior to authorizing new infrastructure deployments in ecologically sensitive areas such as forests, parks, deserts, and wilderness.

vi. Solicit and conduct research which identified harmful impacts, if any, to flora and fauna from base stations and wireless devices, and publish this research annually. Cooperate with the EPA and the USDA in this effort.

vii. Address adverse impacts of RF radiation on specific species when evidence indicates species-specific sensitivities.

[239] Jérémy S. P. Froidevaux et al., *Addressing Wildlife Exposure to Radiofrequency Electromagnetic Fields: Time for Action*, 11(1) Env't Sci. & Tech. Letters 3 (2024), https://pubs.acs.org/doi/10.1021/acs.estlett.3c00795. *See also* S. Sivani & D. Sudarsanam, *Impacts of radio-frequency electromagnetic field (RF-EMF) from cell phone towers and wireless devices on biosystem and ecosystem-a review*. 4(4) Biology & Med. 202 (2012), https://www.walshmedicalmedia.com/open-access/impacts-of-radiofrequency-electromagnetic-field-rfemf-from-cell-phone-towers-and-wireless-devices-on-biosystem-and-ecosystem-a-review-0974-8369-4-179.pdf; B. Blake Levitt et al., *Effects of non-ionizing electromagnetic fields on flora and fauna, Part 3. Exposure standards, public policy, laws, and future directions*, *supra* note 189; Albert M. Manville II et al., *Health and environmental effects to wildlife from radio telemetry and tracking devices—state of the science and best management practices*, 11 Frontiers Veterinary Sci. 1283709 (2024), https://doi.org/10.3389/fvets.2024.1283709.

6. Revelations Were Omitted From the Administrative Record and the Court Record Concerning Radiation Limits Being Exceeded By Devices and Networks.

The Commission's 2013 inquiry stated, "Specifically, we seek comment on the feasibility of evaluating portable RF sources without a separation distance when worn on the body to ensure compliance with our limits under present-day usage conditions."[240] Then, after the six-year Inquiry, the Commission determined in its *2019 Order* that while some claim "evaluation procedures for phones should require testing with a 'zero' spacing—against the body—this is unnecessary."[241]

However records released [242] to Environmental Health Trust in 2023 under a FOIA request show that in 2019, just before the Commission decided against changing SAR test separation distance limits, FCC engineers had tested cell phones at 2 mm from the body and they found tested smartphone models that exceeded its SAR limits in this position. Yet the same phones were within RF limits when tested at ranges from 5 to 15 mm. It is troubling that this data was not publicly released at the time it was initially available, nor was it later placed in the public record or in the court record prior to the issue of the court mandate.

The FCC conducted certain troubling 2 mm SAR tests in 2017 that showed cell phones exceeding radiation limits. Later, there was a pivotal August 21, 2019 Chicago Tribune investigation[243] which found cell phones violating the FCC SAR limit. The Tribune had SAR

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[240] *Reassessment of Federal Communications Commission Radiofrequency Exposure Limits and Policies,* Notice of Inquiry, ET Docket No. 13-84, ¶¶ 7 (2013), https://docs.fcc.gov/public/attachments/FCC-13-39A1.pdf.

[241] *Reassessment of Federal Communications Commission Radiofrequency Exposure Limits and Policies*, Resolution of Notice of Inquiry, ET Docket No. 19-226, ¶¶ 14 (adopted Nov. 27, 2019).

[242] *Press Release: Concealed FCC Cell Phone Radiation Tests Show Human 'Exposure Limits Were Exceeded'*, Environmental Health Trust (Apr. 22, 2024), https://ehtrust.org/press-release-concealed-fcc-cell-phone-radiation-tests-show-human-exposure-limits-were-exceeded/.

[243] Sam Roe, *We tested popular cellphones for radiofrequency radiation. Now the FCC is investigating.*, Chi. Trib., Aug. 21, 2019, https://www.chicagotribune.com/investigations/ct-cell-phone-radiation-testing-20190821-72qgu4nzlfda5kyuhteiieh4da-story.html (updated June 14, 2024) (last visited July 16, 2025).

tested phones at the manufacturer's separation distance from the body phantom and importantly, also at 2 mm distance to mimic a phone in the pocket. The FCC then further investigated, testing certain cell phone models in their laboratories in the same positions as the Tribune. The 2023 FCC FOIA letter to EHT states that the FCC "observed that at a 2 mm separation distance, the FCC RF exposure limits were exceeded…"[244] That critical information never made it into the administrative record in ET Dockets 13-84 and 19-226, nor into the Court record.

The documents released under FOIA include FCC's spreadsheet of the 2mm SAR data which had bold red letters at the top "*CONFIDENTIAL* *FCC INTERNAL ONLY* *NOTE: THE FOLLOWING RESULTS ARE FROM SAR TESTS AT A SEPARATION DISTANCE NOT IN ACCORDANCE WITH FCC GUIDANCE." [245] While it is true that the 2 mm test's separation distance is not required for FCC compliance, we question the FCCs verbiage that asserts testing with a 2 mm separation is contrary to FCC "guidance," as FCC guidance has allowed RF emitting devices to be tested for SAR compliance using a minimum test separation distance "not to exceed" 5, 10 or 25 mm.[246]

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[244] Letter from Ronald T. Repasi, Chief Engineer, Off. of Eng'g & Tech, FCC, to Theodora Scarato, Environmental Health Trust (Sept. 29, 2023), https://ehtrust.org/wp-content/uploads/EHT-Letter-FOIA-Control-No.-2023-000281-and-000325-Theodora-Scarato-Response-Letter_092923-copy.pdf.

[245] *2mm SAR Tests Show FCC Limits Exceeded for Multiple Cell Phones*, Environmental Health Trust (Sept. 29, 2023), https://ehtrust.org/wp-content/uploads/FCC-2mm-SAR-Tests-Show-FCC-Limits-Exceeded-for-Multiple-Cell-Phones.pdf.

[246] Numerous devices in use today in the United States were SAR tested for compliance with separation distances that range from a distance of 5 mm to up to 25 mm. FCC documents have changed over the years. The October 23, 2015 *RF Exposure Procedures and Equipment Authorization Policies for Mobile and Portable Devices* states, "this distance is determined by the handset manufacturer according to the typical body-worn accessories users may acquire at the time of equipment certification, but not more than 2.5 cm, to enable users to purchase aftermarket body-worn accessories with the required minimum separation." Off. of Eng'g & Tech., *RF Exposure Procedures and Equipment Authorization Policies for Mobile and Portable Devices*, Federal Communications Commission (Oct. 23, 2015), https://apps.fcc.gov/kdb/GetAttachment.html?id=f8IQgJxTTL5y0oRi0cpAuA%3D%3D&desc=447498%20D01%20General%20RF%20Exposure%20Guidance%20v06&tracking_number=20676 at 11. The 2015 document also states, "Specific information must be included in the operating manuals to enable users to select body-worn accessories that meet the minimum *test separation distance* requirements. Users must be fully informed of the operating requirements and restrictions, to the extent that the typical user can easily understand the information, to acquire the required body-worn accessories to maintain compliance. Instructions on how to place and orient a device in body-worn accessories, in accordance with the test results, should also be included in the user instructions. All

Instead of sharing all the SAR test measurements, the FCC publicly released a report dated December 10, 2019,[247] ostensibly summarizing the results of its SAR tests of the Chicago Tribune models but *omitting* the 2 mm tests. Cell phone customers often use cell phones pressed against the skin—much closer than 2 mm from the body. The publicly released report was also sent to the Chicago Tribune only sharing the results of FCC's SAR tests that used the larger (5, 10 or 15 mm) separation distances announcing that, "CONCLUSION All sample cell phones tested by the FCC Laboratory…comply with the FCC RF radiation exposure for general population/uncontrolled limits…"

In turn, the Chicago Tribune—without seeing the hidden reports about cell phones exceeding radiation limits at 2 mm from the body—then ran a follow up story titled "FCC says tests find cellphones comply with federal limits" which concluded with the statement: "FCC's recent study did not test phones at the 2mm distance."[248] The FCC apparently did not contact the Tribune to correct this statement.

The FCC's 2023 letter to EHT seems to attempt to explain why it did not take enforcement action on the violations by stating, "…we release our 2 mm separation distance test

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supported body-worn accessory operating configurations must be clearly disclosed to users, through conspicuous instructions in the user guide and user manual, to ensure unsupported operations are avoided." Id. However, the November 29, 2021 *RF Exposure Procedures and Equipment Authorization Policies for Mobile and Portable Devices* states, "A test separation distance not exceeding 5 mm shall be applied to determine SAR-based test exemption or SAR values," and "A test distance of up to 10 mm may be applied if prior approval from the FCC is confirmed via a KDB inquiry that smaller distances are not possible for normal operation of host devices in a platform." Off. of Eng'g & Tech., *RF Exposure Procedures and Equipment Authorization Policies for Mobile and Portable Devices*, Federal Communications Commission (Nov. 29, 2021), https://apps.fcc.gov/kdb/GetAttachment.html?id=Z0Stk%2FPOk2hqHgYJNt%2FRlQ%3D%3D&desc=447498%20D04%20Interim%20%20General%20RF%20Exposure%20Guidance%20v01&tracking_number=20676 at 25 (first quote), fn. 30 (second quote). The FCC's revised guidance regarding shorter separation distance may indicate that the FCC has acknowledged since 2021 that its test procedures are defective, yet the FCC has not updated its regulations.

[247] Federal Communications Commission, *Results of Tests on Cell Phone RF Exposure Compliance* (Dec. 10, 2019), https://docs.fcc.gov/public/attachments/DOC-361473A1.pdf.

[248] Joe Mahr, *FCC says tests find cellphones comply with federal limits on radiofrequency radiation*, Chi. Trib., June 14, 2024, https://www.chicagotribune.com/2019/12/20/fcc-says-tests-find-cellphones-comply-with-federal-limits-on-radiofrequency-radiation/ (originally published Dec. 20, 2019).

results with the caveat that the 2 mm separation distance test results are inconsistent with FCC practice, and are misleading because they reflect extreme conditions."[249]

However, today's reality is that cell phones are commonly used at 2 mm to 0 mm from the bodies by people of all ages, including infants, toddlers, children, teenagers and adults. Such close body positions are *typical*, not "extreme."

Furthermore, it is important that compliance tests use a worst-case scenario and transmit at highest power. A California Department of Health study published just months before the FCC tested cell phones in 2019 titled "Real-world cell phone radiofrequency electromagnetic field exposures"[250] found phones can increase RF emissions to their highest power (10,000 higher) under certain real-world conditions.

In its 2023 FOIA letter to EHT, the FCC further defended its decision not to take enforcement action on the RF exceedances it documented, stating that "given that the RF exposure limit includes a significant safety margin, none of the results suggest there is any RF safety issue with the devices tested."[251]

However, as presented earlier in this petition, the FCC has not adequately clarified at what specific local SAR the FCC will take enforcement action.

As detailed throughout this petition, the "safety margin" is based on a threshold only pertinent to adverse thermal effects, not non-thermal biological impacts. However, even in

[249] Letter from Ronald T. Repasi, Chief Engineer, Off. of Eng'g & Tech, FCC, to Theodora Scarato, Environmental Health Trust (Sept. 29, 2023), https://ehtrust.org/wp-content/uploads/EHT-Letter-FOIA-Control-No.-2023-000281-and-000325-Theodora-Scarato-Response-Letter_092923-copy.pdf at 2.
[250] Stephen Wall et al., *Real-world cell phone radiofrequency electromagnetic field exposures*, 171 Env't Rsch. 581 (Apr. 2019), https://doi.org/10.1016/j.envres.2018.09.015.
[251] Letter from Ronald T. Repasi, Chief Engineer, Off. of Eng'g & Tech, FCC, to Theodora Scarato, Environmental Health Trust (Sept. 29, 2023), https://ehtrust.org/wp-content/uploads/EHT-Letter-FOIA-Control-No.-2023-000281-and-000325-Theodora-Scarato-Response-Letter_092923-copy.pdf.

regards to heating impacts, the safety factor for the local SAR limit used in cell phone test compliance procedures has not been specifically enumerated by the FCC.

In addition to the 2 mm SAR data, EHT's FOIA documents include records of a DDM Brand cell phone model, the Andy 5.5M LTE VR, recalled on February 16, 2016, due to RF limit violations found in post-market surveillance tests.[252] 'The FOIA documents state the FCC was poised to take enforcement action for the Andy phone if the RF exceedances were not addressed. On February 2, 2017, Kaveh Moraghebi of Bay Area Compliance Laboratories stated that, "Per FCC regulation for this type of issue, this result was reported to the FCC directly, and they responded with the following: 'Please inform them that if they do not provide, in a few days, a corrective action and confirm that they have stopped selling non-compliant units, Enforcement action by the FCC will need to be taken. They need respond as soon as possible.'"[253]

Although the Andy DDM Brand did show SAR levels in excess of the FCC SAR limit when tested in FCC's standardized test positions and the FCC's 2 mm test were in positions not required by the FCC for compliance, the DDM brand enforcement action raises critical questions. Why did the FCC force the Andy 5.5M LTE VR, to be recalled due to RF limit violations of 170 percent of the limit, yet did not take corrective action on the models the FCC tested which measured at 120 to 320 percent of the SAR limit?[254]

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[252] DDM Brands LLC, *Post Market Surveillance Summary for ANDY 5.5M LTE VR*, Federal Communications Commission (Mar. 17, 2017), https://ehtrust.org/wp-content/uploads/PMST-SAR-Report-Mar-22-2017.pdf.

[253] Email from Kaveh Moraghebi, Quality Assurance Manager, Bay Area Compliance Laboratories, to Renato Tavares, DDM Brands LLC (Feb. 2, 2017), https://ehtrust.org/wp-content/uploads/DDM-Corrective-Action-Feb-6-2017.pdf at 2.

[254] The Andy 5.5M LTE VR measured 2.64 W/kg and 2.83 W/kg. However, the Commission did not take action for: Apple's iPhone XS, with a SAR at 2.340 and 1.990 W/kg; Samsung's Galaxy S9 at 4.520 and 4.380 W/kg; Samsung's Galaxy J3 SAR at 5.200 and 5.140 W/kg; Motorola's Moto g6 at 1.980 W/kg; nor BLU's Vivo 5 Mini at 2.200 and 2.750 W/kg. *See Federal Communications Commission (FCC) Release of 11 Records to the Environmental Health Trust (EHT) in response to a Freedom of Information Act (FOIA)*, Environmental Health Trust (Apr. 21, 2024), https://ehtrust.org/federal-communications-commission-fcc-release-of-11-records-to-the-

On one hand, the FCC states in several filings that the existence of a safety margin ensures safety even if the levels exceed limits and used this argument not to take action on the SAR levels documented in the 2 mm tests. On the other hand, the FCC enforced its SAR limit with the Andy phone, potentially indicating selective or occasional enforcement of the limits. The FCC must specify what SAR level (and at what separation distance) in excess of the RF radiation limit of 1.6 W/kg will trigger enforcement action against a non-compliant device manufacturer.

7. New FCC-Certified Lab Studies About Cell Phone Radiation Limits Being Exceeded Raises Further Concerns About the Issues Revealed by the FOIA.

Pursuant to the Block v. Nokia case, an FCC-certified lab was hired to run SAR tests on some of the cell phones the plaintiff, an intracerebral hemorrhage victim, used prior to her injury. Phones were tested by the FCC-certified lab at distances of 0, 2, and 5 mm from the body. FCC radiation limits exceedances were found at all distances. For example, an iPhone 6s, exceeded the FCC's radiation exposure limits when operated at 5 mm from the body, coming in at 2.75 W/kg, well over the FCC's 1.6 W/kg limit.[255] Hundreds, if not thousands of cell phone models are in circulation and it is extremely likely they have not been independently tested in an FCC-certified lab. Based on the Block v. Nokia tests, and on the FOIA results, it is apparent that there may be systematic problem with many more cell phone models operating in excess of the FCC limits. It is recommended that all models in circulation be tested for ongoing compliance with the FCC's standards. It is also recommended that the SAR standards be tightened to reduce radiation exposure.

environmental-health-trust-eht-in-response-to-a-freedom-of-information-act-foia-re-foia-control-nos-2023-000281-and-2023-0003/.

[255] Plaintiff's Supplemental Filing, Ex. 1, Block v. Nokia, No. 2015 CA 002114 B, *supra* note 20.

8. **New Developments in Medical Research, Law, Policy and Technology Require a Further Sense of Urgency**

Subsequent to the Court's October 5, 2021 mandate, several material developments have occurred that have *intensified the need for urgent FCC action in response to the Court's directives*, including, but not limited to:

1. February 13, 2025 Executive Order 14212, establishing the MAHA Commission. The Order identifies "electromagnetic radiation" as a subject of study in efforts to combat childhood chronic disease in the United States.[256]
2. Comments from the U.S. Secretary of Health, Robert F. Kennedy Jr., underscoring the need to remove cell phones from schools due to public health concerns.[257]
3. The publication of a 2025 World Health Organization-commissioned scientific review concluding high certainty that RF electromagnetic field ("EMF") exposure increases the incidence of cancer in experimental animals, with the certainty of evidence being strongest for malignant heart schwannomas and gliomas.[258]
4. A 2025 IEEE article by Dr. James C. Lin, former member of the International Commission on Non-Ionizing Radiation Protection ("ICNIRP") and one of the world's leading experts on the biological effects of RF radiation, argues that the WHO-EMF Project's reviews are methodologically flawed, narrowly focused on thermal effects, and shaped by conflicts of interest, all ultimately undermining the scientific integrity of global RF-EMF exposure guidelines.[259]

[256] Exec. Order No. 14212, *supra* note 13.
[257] *RFK Jr. launches investigation into 'high levels' of heavy metals in baby formula*, *supra* note 14.
[258] Meike Mevissen et al., *supra* note 15.
[259] James C. Lin, *supra* note 16.

5. A 2023 IEEE "Health Matters" article, also by Dr. James C. Lin, stating: "This review discusses the assumptions underlying the standards and the outdated exposure metrics employed and concludes that the revised guidelines do not adequately protect children, workers, or the public from exposure to RF radiation or people with sensitivity to electromagnetic radiation from wireless devices and systems."[260]
6. A 2022 publication by the International Commission on the Biological Effects of Electromagnetic Fields[261] stating: "In this paper, we show how the past 25 years of extensive research on RFR demonstrates that the assumptions underlying the FCC's and ICNIRP's exposure limits are invalid and continue to present a public health harm."[262]
7. Freedom of Information Act ("FOIA") records and FCC-certified lab results that reveal non-compliance with the Commission's RF radiation exposure limits for both wireless devices and wireless telecommunications infrastructure.[263]
8. The New Hampshire 5G Commission, established through bi-partisan legislation in 2019,[264] published its final report in November of 2020.[265] The report contains 15 recommendations intended "to bring about greater awareness of cell phone, wireless and 5G radiation health effects and to provide guidance to officials on steps and policies that can reduce public exposure."[266]

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[260] James C. Lin, *supra* note 17.
[261] *Supra* note 18.
[262] Int'l Comm'n on the Biological Effects of Electromagnetic Fields (ICBE-EMF), *supra* note 19.
[263] *See* EHT, *Federal Communications Commission (FCC) Release of 11 Records to the Environmental Health Trust (EHT) in response to a Freedom of Information Act (FOIA*), *supra* note 20.
[264] HB 522, *supra* note 22.
[265] *Final Report of the Commission to Study The Environmental and Health Effects of Evolving 5G Technology*, *supra* note 23.
[266] Id. at 8.

9. An analysis of the NIH National Toxicology Program ("NTP") RF radiation study which concluded that the Commission's RF radiation exposure limits should be reduced by at least 200 to 400 times to adequately protect children.[267]
10. A burgeoning state court record about alleged health harms resulting from wireless devices.[268]
11. MDL filed by 35 State Attorneys General against social media companies concerning addiction to their products.[269] Addiction to social media is fueling increased daily use of wireless devices which increases users' duration and proximity to RF radiation exposure emitted by such wireless devices.
12. The United States Supreme Court ruling in Loper Bright Enterprises v. Raimondo, which eliminated the doctrine of *Chevron* deference—now enabling courts to utilize their independent judgement as to whether agencies acted within their statutory authority.[270]

In light of these developments, as well as others discussed throughout this Petition, the need for the Commission to comply with the Court mandate has only grown more urgent.

CONCLUSION

It has been nearly four years since the D.C. Circuit Court of Appeals ruled that the Commission abdicated its duty to comply with the Administrative Procedure Act for its failure to adequately consider a robust body of peer-reviewed, scientific literature demonstrating the urgent need for updated RF radiation exposure limits in the United States. Current exposure limits

[267] *Supra* note 25.
[268] Block v. Nokia, No. 2015 CA 002114 B *supra* note 26.
[269] As of July 11, 2025, over 1,867 civil cases are consolidated under the MDL. *See supra* note 27.
[270] Loper Bright Enterprises v. Raimondo, 603 U.S. 369 *supra* note 28.

grossly exceed those of other developed countries like China and Russia. In the interest of protecting public health, public safety, and the environment, it is imperative that the Commission promptly comply with the mandate.

For all the reasons cited herein, pursuant to 47 C.F.R. § 1.1, EHT petitions and requests that the Commission promptly comply with the judgment and mandate issued by the United States Court of Appeals for the District of Columbia Circuit in No. 20-1025, EHT v. FCC.

Respectfully submitted, Date: August 6, 2025

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ATTACHMENT 1

Best Practice Recommendations Regarding Systematic Reviews On Human Health Risks Posed By Environmental Exposures.

1. National Academies of Sciences, Engineering, and Medicine et al., *Application of Systematic Review Methods in an Overall Strategy for Evaluating Low-Dose Toxicity from Endocrine Active Chemicals* (2017), https://doi.org/10.17226/24758.
2. Rebecca L. Morgan et al., *GRADE: Assessing the quality of evidence in environmental and occupational health*, 92-93 Env't Int'l 611 (2016), https://doi.org/10.1016/j.envint.2016.01.004.
3. Andrew A. Rooney et al., *Systematic Review and Evidence Integration for Literature-Based Environmental Health Science Assessments*, 122(7) Env't Health Persps. 711 (2014), https://doi.org/10.1289/ehp.1307972.
4. Paul Whaley et al., *Recommendations for the conduct of systematic reviews in toxicology and environmental health research (COSTER)*, 143 Env't Int'l 105926 (2020), https://doi.org/10.1016/j.envint.2020.105926.

ATTACHMENT 2

EMF Exposure & Presence of Metal Objects

1. V. Anderson & K.H. Joyner, *Specific absorption rate levels measured in a phantom head exposed to radio frequency transmissions from analog hand-held mobile phones*, 16(1) Bioelectromagnetics 60 (1995), https://doi.org/10.1002/bem.2250160112.
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3. Mudafara S. Bengleil et al., *Evaluation of Salivary Nickel Level during Orthodontic Treatment*, 7(12) Int'l J. Med., Health, Biomedical & Pharm. Eng'g 668 (2013), https://www.researchgate.net/profile/Iman-Abdelgader/publication/283258458_Evaluation_of_Salivary_Nickel_Level_during_Orthodontic_Treatment/links/562f5a7608aeb2ca6961f5b4/Evaluation-of-Salivary-Nickel-Level-during-Orthodontic-Treatment.pdf.
4. Yana Chervona et al., *Carcinogenic Metals and the Epigenome: Understanding the Effect of Nickel, Arsenic, and Chromium*, 4(7) Metallomics 619 (2012), https://doi.org/10.1039/c2mt20033c.
5. Kusal K. Das et al., *Nickel, Its Adverse Health Effects & Oxidative Stress*, 128(4) Indian J. Med. Rsch. 412 (2008), https://www.researchgate.net/publication/23688113_Nickel_its_adverse_health_effects_oxidative_stress.
6. Jose Fayos-Fernandez et al., *Effect of Pierced Metallic Objects on SAR Distributions at 900 MHz*, 27(5) Bioelectromagnetics 337 (2006), https://doi.org/10.1002/bem.20245.
7. Yangchun Gao et al., *Safety Assessment of Human with Metal Implants Exposed to Magnetic Field Based on Numerical Method*, in 2023 4th Int'l Conf. on Comput. Eng'g & Application (ICCEA) 56 (2023), https://doi.org/10.1109/ICCEA58433.2023.10135522.
8. Niyazi İl et al., *Electromagnetic Field Exposure to Human Head Model with Various Metal Objects at Sub-6 GHz Frequencies*, 42(3) Electromagnetic Biology & Med. 114 (2023), https://doi.org/10.1080/15368378.2023.2220736.
9. Ervin Joó et al., *Metal-Framed Spectacles and Implants and Specific Absorption Rate Among Adults and Children Using Mobile Phones at 900/1800/2100 MHz*, 25(2) Electromagnetic Biology & Med. 103 (2006), https://doi.org/10.1080/15368370600719042.
10. Junqing Lan et al., *Evaluation of Microwave Microdosimetry for Human Eyes with Glasses Exposed to Wireless Eyewear Devices at Phone Call State*, 63 Progress Electromagnetic Rsch. M 71 (2018), http://dx.doi.org/10.2528/PIERM17080802.
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12. Ghazal Mortazavi & S.M.J. Mortazavi, *Increased Mercury Release from Dental Amalgam Restorations After Exposure to Electromagnetic Fields as a Potential Hazard for Hypersensitive People and Pregnant Women*, 30(4) Revs. on Env't Health 287 (2015), https://doi.org/10.1515/reveh-2015-0017.
13. Gh Mortazavi et al., *Increased Release of Mercury from Dental Amalgam Fillings due to Maternal Exposure to Electromagnetic Fields as a Possible Mechanism for the High Rates of Autism in the Offspring: Introducing a Hypothesis*, 6(1) J. Biomedical Physics & Eng'g 41 (2016), https://pmc.ncbi.nlm.nih.gov/articles/PMC4795328/.

14. S.M.J. Mortazavi et al., *High-Field MRI and Mercury Release from Dental Amalgam Fillings*, 5(2) Int'l J. Occupational & Env't Med. 101 (2014), https://pmc.ncbi.nlm.nih.gov/articles/PMC7767616/.
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19. Ramya Rajendran et al., *Effect of Mobile Phone with and without Earphones Usage on Nickel Ion Release from Fixed Orthodontic Appliance*, 24(5) J. Contemp. Dental Prac. 303 (2023), https://doi.org/10.5005/jp-journals-10024-3475.
20. Mohammad Ali Saghiri et al., *Effect of Mobile Phone Use on Metal Ion Release from Fixed Orthodontic Appliances*, 147(6) Am. J. Orthodontics & Dentofacial Orthopedics 719 (2015), https://doi.org/10.1016/j.ajodo.2015.01.023.
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ATTACHMENT 3

Children's Heightened RF Radiation Absorption Compared to Adults

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ATTACHMENT 8

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ATTACHMENT 11

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ATTACHMENT 12

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ATTACHMENT 17

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ATTACHMENT 20

EMFs & Auditory/Aural Impacts

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2. Samira Souffi et al.**,** *Exposure to 1800 MHz LTE electromagnetic fields under proinflammatory conditions decreases the response strength and increases the acoustic threshold of auditory cortical neurons*, 12(1) Sci. Rep. 4063 (2022), https://doi.org/10.1038/s41598-022-07923-9
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ATTACHMENT 21

Studies Document EMF Exposure Levels in Varying Environments

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2. Bhatt, Chhavi Raj et al., *Radiofrequency-electromagnetic field exposures in kindergarten children*, 27(5) J. Exposure Sci. & Env't Epidemiology 497 (2017), https://doi.org/10.1038/jes.2016.55.
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4. Boussad, Yanis et al., *Longitudinal study of exposure to radio frequencies at population scale*, 162 Env't Int'l 107144 (2022), https://doi.org/10.1016/j.envint.2022.107144.
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6. Carlberg, Michael et al., *High ambient radiofrequency radiation in Stockholm city, Sweden*, 17(2) Oncology Letters 1777 (2019), https://doi.org/10.3892/ol.2018.9789.
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10. Hardell, Lennart et al., *Radiofrequency radiation at Stockholm Central Railway Station in Sweden and some medical aspects on public exposure to RF fields*, 49(4) Int'l J. Oncology 1315 (2016), https://doi.org/10.3892/ijo.2016.3657.
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12. Koppel, Tarmo et al., *Radiofrequency radiation from nearby mobile phone base stations-a case comparison of one low and one high exposure apartment*, 18(5) Oncology Letters 5383 (2019), https://doi.org/10.3892/ol.2019.10899.
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ATTACHMENT 22

Biological Effects of mm-Wave and sub-mm Wave RF Radiation Exposures

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ATTACHMENT 23

Role of Modulation in Diverse Biological Effects of Non-Thermal Microwaves

(*in vitro* and *in vivo*)

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   "The frequency of pathological rats was 170/481 (0.35 ± 0.03) among rats exposed to pulse modulated (PW) and 74/149 (0.50 ±0.07) among rats exposed to continuous wave exposure (CW). These results are both highly significantly different to their corresponding controls (p <0.0001) and the frequency of pathological rats after exposure to pulsed radiation (PW) is significantly less (p < 0.002) than after exposure to continuous radiation (CW)."

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   "Comparison of these results suggests that effects are much more robust when the modulation causes low-frequency periodic changes in the amplitude of the microwave carrier."

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EMF Impacts on Plants

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6. Dmitry S. Pesnya & Anton V. Romanovsky, *Comparison of cytotoxic and genotoxic effects of plutonium-239 alpha particles and mobile phone GSM 900 radiation in the* Allium cepa *test*, 750(1-2) Mutation Rsch./Genetic Toxicology & Env't Mutagenesis 27 (2013), https://doi.org/10.1016/j.mrgentox.2012.08.010.
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ATTACHMENT 25

Occupational Exposures to EMFs

1. Karpowicz Jolanta et al., *The nature of radiofrequency electromagnetic exposure to outdoor workers active in the harbour versus the city centre*, 2023 Int'l Symposium on Electromagnetic Compatibility – EMC Europe 1 (2023), https://doi.org/10.1109/EMCEurope57790.2023.10274224.
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ATTACHMENT 26

Radiofrequency Radiation Exposure Limits by Country

See International Commission on Non-Ionizing Radiation Protection, *Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (Up to 300GHz)*, 74(4) Health Physics 494 (1998), https://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf.

In relation to electromagnetic field exposure at 1800 MHz, a power density of 0.1 W/m² has significance within the context of guidelines set by organizations like ICNIRP. This is also equivalent to 6 V/M.

Here is how these elements relate:

- ICNIRP Guidelines: ICNIRP establishes guidelines for limiting human exposure to electromagnetic fields (EMF) to protect against known adverse health effects. These guidelines cover a wide frequency range, including the 1800 MHz band commonly used in mobile communications. The guidelines are based on scientific review and focus on preventing adverse health effects.
- 1800 MHz: This frequency band is widely used in mobile phone networks and other wireless communication technologies.
- Power Density (W/m²): Power density measures the strength of the electromagnetic field at a given location. It is expressed in watts per square meter (W/m²) and describes the rate of energy transfer per unit area.
- 0.1 W/m²: Within the ICNIRP framework, a power density of 0.1 W/m² (equivalent to 100 mW/m² and 6V/m) is often associated with public exposure limits in sensitive areas like schools, hospitals, and homes, where people might experience prolonged exposure. While the ICNIRP general public exposure limit at 1800 MHz is higher (approximately 10 W/m²), the 0.1 W/m² figure serves as a point of reference or an "attention value" in certain scenarios to ensure EMF levels remain below the general exposure limit and to provide additional protection in specific environments. It is crucial to understand that exceeding this "attention value" does not necessarily mean exceeding safety limits, but it might warrant further assessment depending on the specific circumstances of exposure.

In essence, 0.1 W/m² represents a precautionary or attention level for RF exposure at 1800 MHz, particularly in areas where people may spend considerable time, even though the general exposure limit set by ICNIRP is higher.

See also Ting Wu et al., *Safe for Generations to Come*, 16(2) IEEE Microwave Mag. 65 (2015), https://pmc.ncbi.nlm.nih.gov/articles/PMC4629874/ at Table 1, included on the next page, for a table which lists RF exposure limits for several countries.

TABLE 1.

The variations of exposure limits to RF radiation in several countries.

Country/Guidelines	PD Restrictions for the General Public in W/m^2	PD Restrictions for the General Public in mW/cm^2	Frequency Range (GHz)	Basis
ICNIRP [17] (1998)	10	1	2–300	Science based
FCC [16] (1996)	10	1	1.5–100	Science based
China [32] (1987)*	0.1	0.01	0.3–300	Science based
Russia [33] (2003)	0.1	0.01	0.3–300	Science based
Switzerland [34] and [35] (2000)*	0.1	0.01	1.8–300	Precautionary
Italy [36] (2003)*	0.1	0.01	0.0001–300	Precautionary
Typical maximum exposure from cellular base station mounted on 50-m tower (assuming a total effective radiated power of 2,500 W in each sector, summed over all channels)	0.01	0.001	1–2	Example from [29]

Open in a new tab

*These restrictions only apply to sensitive areas, such as school, hospital, or rooms in buildings, where they are regularly occupied by persons for prolonged periods.

RF Exposure Limits for Several Countries

RF Exposure Limits by Country

UNITED STATES

Radiofrequency radiation exposure limits, 47 C.F.R. § 1.1310 (2024), https://www.ecfr.gov/current/title-47/section-1.1310.

Look under Table 1 for frequencies greater than or equal to 1500 MHz where it lists Power Density = 1.0 mW/cm2 = 10 W/m2

See also Federal Communications Commission, OET Bull. No. 65, *Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields* (1997), https://transition.fcc.gov/oet/info/documents/bulletins/oet65/oet65.pdf.

Exposure Limit on graph provided (W/M2 @ 1800 MHz) = 10 W/M2 ~ 61.4 V/M (IEEE/ANSI FCC1.1310)

• Limit: 10 W/m²

• Statement: Power density: 1.0 mW/cm² (i.e., 10 W/m²) for frequencies ≥ 1.5 GHz.

• URL: https://www.ecfr.gov/current/title-47/section-1.1310

Limits:

- Specific Absorption Rate (SAR) for Wireless Devices: 1.6 W/kg averaged over 1 gram of tissue for partial body exposure (e.g., head and trunk).
- Power density public exposure limit: varies by frequency, e.g., 0.57 mW/cm² at 900 MHz 0.053 mW/cm² to 1 mW/cm² (0.53 W/m² to 10 W/m²) depending on frequency, with typical limits around 0.58 mW/cm² (5.8 W/m²) for frequencies used by cell towers (e.g., 850 MHz to 2600 MHz).
- For whole-body exposure, the limit is 0.08 W/kg.

Other Citations:

Federal Communications Commission, OET Bull. No. 65, *Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields* (1997), https://transition.fcc.gov/oet/info/documents/bulletins/oet65/oet65.pdf.

Federal Communications Commission, *Radio Frequency Safety*, fcc.gov, https://www.fcc.gov/general/radio-frequency-safety-0 (last visited Jul. 10, 2025).

Notes:

The FCC's limits are based on recommendations from the IEEE and the National Council on Radiation Protection and Measurements (NCRP), focusing primarily on preventing thermal effects.

JAPAN

Ministry of Internal Affairs and Communications.

Exposure Limit on graph provided (W/m^2 @ 1800 MHz) = 10 (ICNIRP recommendations)

Japan – Public RF Exposure Limit

ICNIRP Guidelines (Adopted by Japan) While Japan does not explicitly state limits in its own law, it adopts the ICNIRP reference levels, including the 10 W/m² power density for frequencies between 10 MHz and 10 GHz—covering the 1800 MHz band.

ICNIRP PDF – Table 7 (Reference Levels for General Public Exposure, Power Density) The table lists:

10 W/m² for the 10 MHz–10 GHz range

This is the applicable band for 1800 MHz --- Additional Confirmation A WHO Global Health Observatory (GHO) data entry confirms that most countries—including Japan—use ICNIRP's 10 W/m² guideline for public exposure: Check the Power Density section in this interactive chart: Japan, USA, etc. all listed at 10 W/m².

Summary for Japan Uses ICNIRP guidelines directly, with 10 W/m² as the general public power density limit for frequencies above ~10 MHz While the limit is not restated on Japanese government websites, the adoption of ICNIRP standards is official and documented.

See Ministry of Internal Affairs and Communications, Japan, *Frequently Asked Questions: Regulatory Issues*, Japan EMF Information Center, https://www.jeic-emf.jp/english/public/faq/regulation/index.html (last visited Jul. 10, 2025).

Example: *See RF Exposure Information/Specific Absorption Rate (SAR) Information: Xperia Ace III*, Y! Mobile, https://www.ymobile.jp/app/manual/a203so/pc/18-04.html (last visited Jul. 10, 2025).

See also RF Exposure Information/Specific Absorption Rate (SAR) Information: OPPO Reno3 A, Y! Mobile, https://www.ymobile.jp/app/manual/reno3a/sp/17-04.html (last visited Jul. 10, 2025).

Japanese Radio Law: *See* Japan Quality Assurance Organization, *Japan Radio Law: JQA Information Booklet & Application Guide*, jqa.jp (May 11, 2023), https://www.jqa.jp/english/safety/file/guide_radio_202310.pdf.

• Limit: 10 W/m²

• Statement: Based on ICNIRP guidelines, which Japan follows: Reference level for general public is 10 W/m².

Limits:

- SAR limit for mobile devices: 2 W/kg averaged over 10 g of tissue for partial body exposure
- Power density exposure limits vary by application and frequency. Guideline: 2 W/m² at 400 MHz, increasing to 10 W/m² at 2 GHz and above, following ICNIRP guidelines. Japan tends to always follow these guidelines.
- Whole-body exposure, the limit is 0.08 W/kg.

Citation:

Ministry of Internal Affairs and Communications, Japan, *Guidelines for the protection of the public from radio wave exposure*, Japan EMF Information Center (2020), https://www.jeic-emf.jp/english/rf_guidelines.html.

Access:

The MIC provides information on RF exposure limits through its official website, particularly under the "Radio Use Guidelines" section at

https://www.jeic-emf.jp/english/rf_guidelines.html.

The guidelines are available in Japanese, with some English summaries.

Notes:

Japan's limits are aligned with the International Commission on Non-Ionizing Radiation Protection (ICNIRP) guidelines, which are widely adopted internationally.
The MIC also considers occupational exposure limits, which are higher than those for the general public.

Compliance is ensured through equipment certification and periodic site audits.

AUSTRALIA

See Australian Radiation Protection and Nuclear Safety Agency, *Radiation Protection Series S-1: Standard for Limiting Exposure to Radiofrequency Fields—100 kHz to 300 GHz*, arpansa.gov.au (2021), https://www.arpansa.gov.au/regulation-and-licensing/regulatory-publications/radiation-protection-series/codes-and-standards/rpss-1.

Exposure Limit on graph provided (W/m² @ 1800 MHz) = 9 (ICNIRP via ARPANSA)

See also Department of Infrastructure, Transport, Regional Development, Communications and the Arts, *Exposure limits for electromagnetic energy (EME)*, infrastructure.gov.au,

https://www.infrastructure.gov.au/sites/default/files/documents/eme-factsheet-exposure-limits-for-electromagnetic-energy-from-telecommunications.pdf (last visited July 10, 2025).

• Limit: 10 W/m²

• Statement: The ARPANSA standard aligns with ICNIRP limits. For 1800 MHz, the limit is 10 W/m². Second link states "For 5G infrastructure, the public exposure limit is 10W/m2."

Limits:

- Frequency range: 100 kHz to 300 GHz
- Public exposure limit power density: 0.2 W/m² (varies by frequency) averaged over 10 gm of tissue for partial body exposure
- Power Density for Cell Towers: 2 W/m² at 400 MHz, increasing to 10 W/m² at 2 GHz and above, following ICNIRP guidelines.
- whole-body exposure, the limit is 0.08 W/kg
- Occupational exposure limit power density: 1 W/m²

Citation:

Australian Radiation Protection and Nuclear Safety Agency, *Radiation Protection Standard for Maximum Exposure Levels to Radiofrequency Fields – 3 kHz to 300 GHz*, arpansa.gov.au (2002), https://www.arpansa.gov.au/regulation-and-licensing/regulatory-publications/radiation-protection-series/codes-and-standards/rps3.

ARPANSA's website provides comprehensive information on RF exposure limits, including downloadable standards and fact sheets under the "Radiation Protection" section at

https://www.arpansa.gov.au/understanding-radiation/radiation-sources/more-radiation-sources/mobile-phone-base-stations.

Notes: Australia's limits are based on the ICNIRP guidelines and are regularly reviewed to incorporate the latest scientific research.

ARPANSA emphasizes that typical public exposure from cell towers is well below these limits.

The agency also provides resources on reducing personal exposure to RF fields, though it maintains that current limits are protective of public health.

GREECE

Greece Regulatory Body: Hellenic Atomic Energy Commission (EEAE)

Exposure Limit on graph provided (W/M2 @ 1800 MHz) = 4.5-6 (% ICNIRP)

See Vodafone, *Vodafone Corporate Responsibility Report 2009-2010*, Capital Link Sustainability Hub, https://csringreece.gr/files/reports/en/2010/vodafone_annual_en_2009_2010_high.pdf (last visited Jul. 10, 2025).

See table on page 39 for 1800. Greece follows 70% and 60% of ICNIRP guidelines

Greek Ministry of Health. (2000). Joint Ministerial Decision 53571/3839 on Electromagnetic Field Limits. In Law 3431/2006 and Law 4635/2019. Referenced in: Zinelis, S. (2019). Human RF exposure limits.

Greece-Specific EMF Information: Body of European Regulators for Electronic Communications, *EMF related country-specific information for Greece*, berec.europa.eu, https://www.berec.europa.eu/en/tasks/electromagnetic-fields/emf-related-country-specific-information-for-greece (last visited Jul. 10, 2025).

Limits:

- Public exposure limit: 0.1 W/m² (more stringent than EU recommendation)
- Occupational exposure: 1 W/m²
- Specific Absorption Rate (SAR) for Wireless Devices: 2 W/kg averaged over 10 grams of tissue for partial body exposure.
- Power Density for Cell Towers: 1.4 W/m² at 400 MHz to 7 W/m² at 2 GHz (70% of ICNIRP guidelines).
- In sensitive areas (e.g., schools, hospitals), limits are further reduced to 60% of ICNIRP guidelines.
- For whole-body exposure, the limit is 0.08 W/kg.

Notes: Greece enforces stricter limits than the standard ICNIRP guidelines as a precautionary measure, particularly near sensitive locations. The EEAE conducts regular RF measurements and makes the data publicly available to ensure transparency and compliance.

INDIA

*Note, India has relaxed its RF radiation limits for 5G base stations as of early 2025. *See Kiran Rathee, In relief to telcos, 5G radiation rules eased,* The Economic Times (Jan. 2, 2025), https://economictimes.indiatimes.com/industry/telecom/telecom-news/in-relief-to-telcos-5g-radiation-rules-eased/articleshow/116892570.cms.

Department of Telecommunications, Government of India. (2012). Guidelines for Implementation of EMF Radiation Norms for Telecom Towers.

Exposure Limit on graph provided (W/m² @ 1800 MHz) = 0.45-1 (1/10th ICNIRP)

The Indian Unified License Agreement PDF hosted on an official DoT server contains the exact formula for calculating public exposure limits, including at 1800 MHz, which clearly defines the limit in W/m² Key Quote from Section 24.1 ("Norms on Electromagnetic Field exposure by BTS"). *See* Department of Telecommunications, India, *License Agreement for Unified License*, eservices.dot.gov.in, https://eservices.dot.gov.in/sites/default/files/2024-11/Unified_License_Agreement.pdf (last visited July 10, 2025).

Frequency Range … Power density (Watt/Sq. meter (W/m2) = 400 MHz to 2000 MHz … f/2000 … (f is frequency in MHz)"

--- Calculation for 1800 MHz f/2000 = 1800/2000 = 0.9 w/m2

Indian EMF Guidelines: Department of Telecommunications, India, *Guidelines for EMF radiation from mobile towers*, Tarang Sanchar Portal (2012), https://tarangsanchar.gov.in/emfportal (last visited July 10, 2025).

Limits:

- Public exposure limit: 0.45 W/m² for frequencies above 300 MHz
- Occupational exposure limit: 1.8 W/m²
- Power Density: 0.2 W/m² (0.02 mW/cm²) at 400 MHz to 1 W/m² (0.1 mW/cm²) at 2 GHz and above, set at 10% of ICNIRP 1998 guidelines.
- Specific Absorption Rate (SAR): 1.6 W/kg averaged over 1 g of tissue for mobile devices (stricter than ICNIRP's 2 W/kg over 10 g).

Notes:

India's stringent limits, effective since September 2012, reflect a precautionary approach due to public health concerns and research suggesting potential non-thermal biological effects of RF exposure. The DoT's Tarang Sanchar portal provides public access to EMF compliance data for mobile towers, including real-time emission reports. Local regulations in cities like Mumbai and states like Rajasthan impose additional restrictions, such as minimum distances (50–100 meters) for towers near schools and hospitals to further reduce exposure.

Second Citation:

Department of Telecommunications, India, *Guidelines for EMF radiation from mobile towers*, Tarang Sanchar Portal (2012), https://tarangsanchar.gov.in/emfportal (last visited July 10, 2025).

CHINA

China Regulatory Body: Ministry of Industry and Information Technology (MIIT)

Exposure Limit on graph provided (W/m² @ 1800 MHz) = .10 (Conservative National Std)

See RF Exposure from Mobile Phones, Towers, WiFi, Other RF, Magnetic Sciences, https://magneticsciences.com/RF-health/?srsltid=AfmBOopZXPh6_OYU6lXKgSwqz8KW_H_E_PLRGX_Uu57ZHfii3_N8wFxe (last visited July 10, 2025).

See Standardization Administration of China, *GB 21288-2022: Limits for Human Exposure to Electromagnetic Fields Emitted by Mobile Communication Terminals*, ChineseStandard.net (2022), https://www.chinesestandard.net/PDF/English.aspx/gb21288-2022.

Limits:

- SAR limit for mobile devices: 2 W/kg averaged over 10 g of tissue aligned with ICNIRP guidelines.
- Power density limits vary with frequency; typically ~0.4 W/m² (40 μW/cm²) for cell towers across typical wireless frequencies (e.g., 900 MHz to 2.6 GHz).

Notes:

China's RF exposure limits are significantly stricter than ICNIRP's 2–10 W/m², reflecting a precautionary stance based on concerns about long-term health effects of RF exposure. The limits are outlined in the national standard GB 8702-2014. Compliance is monitored through environmental assessments, and public reporting of RF emission levels is encouraged, though detailed data may be less accessible to non-Chinese speakers.

Second Citation:

Ministry of Industry and Information Technology, China, *GB 8702-2014: Regulations for electromagnetic environment control limits*, ChineseStandard.net (2014), https://www.chinesestandard.net/PDF.aspx/GB8702-2014. Some information behind a paywall.

Ministry of Industry and Information Technology of the People's Republic of China, https://www.miit.gov.cn/ (last visited July 10, 2025).

Secondary source: James C. Lin, *Electromagnetic fields and public health in China*, 200 Env't Rsch. 111486 (2021).

Original, Chinese version of the EME control limits: Ministry of Industry and Information Technology of the People's Republic of China, https://www.miit.gov.cn/ (last visited July 10, 2025)
(Navigate to "Standards" for GB 8702-2014, Chinese-language).

RUSSIA

Russia Regulatory Body: Federal Service for Supervision of Consumer Rights Protection and Human Welfare (Rospotrebnadzor)

Exposure Limit on graph provided (W/M2 @ 1800 MHz) = .10 (Based on old USSR norms)

Ministry of Health, Russian Federation, *Sanpin 2.1.8/2.2.4.1190-03: Hygiene requirements for placement and operation of land mobile radio*, (2003), http://apekspro.ru/files/SanPiN%202.1.8_2.2.4.1190-03.pdf.

See Dariusz Leszczynski, *The lack of international and national health policies to protect persons with self-declared electromagnetic hypersensitivity*, 39(2) Revs. on Env't Health 163, 183 (2024), https://doi.org/10.1515/reveh-2022-0108 (under "Russia" heading).

"The Russian National Committee on Non-Ionizing Radiation Protection (RNCNIRP) was created in 1997 at the Russian Academy of Medical Science (RAMS) within the framework of the Russian Scientific Commission on Radiation Protection (RSCRP). The RSCRP acts as the overseer of the RNCNIRP. The RNCNIRP is an independent scientific organization which does not accept financial sponsorship.

Its decisions are thought of as recommendations and are considered by the Ministry of Health of the Russian Federation when it is setting standards. Mandatory compliance is required with regard to the Sanitary Provisions and Ecological Norms (SanPiN) guidelines set by the Ministry of Health of the Russian Federation. The latest RF-EMF SanPiN 2.1.8/2.2.4.1190-03 (safety standard) on mobile communications was issued by the Ministry of Health of the Russian Federation in 2003.

See Ministry of Health, Russian Federation, *Sanpin 2.1.8/2.2.4.1190-03: Hygiene requirements for placement and operation of land mobile radio*, (2003), http://apekspro.ru/files/SanPiN%202.1.8_2.2.4.1190-03.pdf.

"This decreed that the maximum permissible exposure level for RF-EMF over the frequency range of 300 MHz–300 GHz in the Russian Federation is 10 μW/cm2 (0.1 W/m2)."

Decree of the Chief State Sanitary Doctor of the Russian Federation, No. 18, *On the Introduction of Sanitary Rules and Standards SanPiN 2.1.8/2.2.4.1190-03* (Mar. 13, 2003), https://www.consultant.ru/document/cons_doc_LAW_41563/e2548f0e84a2c01f170d64a93730afcf8c2b89c2/ at Table 3.1, ¶¶ 3.2-3.19.

Limits:

- Public exposure limit: ~10 W/m² for frequencies above 300 MHz.
- Occupational exposure limit: higher but varies with environment and frequency.
- Power Density: 0.1 W/m² (10 μW/cm²) for cell towers, one of the strictest globally.
- Specific Absorption Rate (SAR): 2 W/kg averaged over 10 g of tissue, aligned with ICNIRP guidelines.

Notes:

Russia's RF limits, established under SanPiN 2.1.8/2.2.4.1383-03, are based on extensive research into non-thermal biological effects of electromagnetic fields, dating back to Soviet-era studies. The precautionary approach includes recommendations to limit children's exposure to RF radiation sources and mandatory monitoring of cell tower emissions.

The Russian National Committee on Non-Ionizing Radiation Protection has also advocated for warning labels on RF radiation-emitting devices.

ITALY

Italy Regulatory Body: Ministry of Health and Regional Authorities

Exposure Limit on graph provided (W/m² @ 1800 MHz) = 0.10

See Base Station: Italy, GSMA, https://www.gsma.com/solutions-and-impact/connectivity-for-good/public-policy/wp-content/uploads/2013/06/GSMA_BaseStation_Italy.pdf (last visited July 10, 2025).

See also RF Exposure from Mobile Phones, Towers, WiFi, Other RF, Magnetic Sciences, https://magneticsciences.com/RF-health/?srsltid=AfmBOopZXPh6_OYU6lXKgSwqz8KW_H_E_PLRGX_Uu57ZHfii3_N8wFxe (last visited July 10, 2025).

President of the Council of Ministers, Italy, *DPCM 8 July 2003: Establishment of exposure limits, attention values, and quality goals to protect the population against electric, magnetic, and electromagnetic fields generated at frequencies between 100 kHz and 300 GHz* (2003), http://dorontal.net/NIR_refs/Italy_DPCM_RF_eng.pdf.

Italy-Specific EMF Information: Body of European Regulators for Electronic Communications, *EMF related country-specific information for Italy*, berec.europa.gov https://www.berec.europa.eu/en/tasks/electromagnetic-fields/emf-related-country-specific-information-for-italy (last visited July 10, 2025).

Limits:

- Public exposure: ~0.1 W/m² (1000 µW/cm²) for frequencies around 900 MHz
- Occupational exposure: 10 times the public limit
- Power Density: 0.1 W/m² (10 µW/cm²) in sensitive areas (e.g., homes, schools, hospitals).1 W/m² (100 µW/cm²) in other areas.
- Specific Absorption Rate (SAR): 2 W/kg averaged over 10 g of tissue, aligned with ICNIRP guidelines.

Notes:

Italy's precautionary RF limits, set by the Decree of the President of the Council of Ministers (DPCM) of July 8, 2003, are among the strictest in Europe, driven by public concern and research, such as the Ramazzini Institute's studies linking RF exposure to cancer risks. Over 500 Italian municipalities have passed resolutions to pause 5G deployment until further safety studies are conducted. RF measurements are publicly available, and regulations are stricter near sensitive locations.

President of the Council of Ministers, Italy, *DPCM 8 July 2003: Establishment of exposure limits, attention values, and quality goals to protect the population against electric, magnetic, and electromagnetic fields generated at frequencies between 100 kHz and 300 GHz* (2003), http://dorontal.net/NIR_refs/Italy_DPCM_RF_eng.pdf.

Secondary source: *Electromagnetic field regulations in Italy*, EMF-Portal (2023), https://www.emf-portal.org/en (Secondary source, English, under "Italy Regulations").

Limiti vigenti in Italia, Elettra 2000, https://www.elettra2000.it/it/raccolta-normative/102-limiti/limiti-italia.html (last visited July 23, 2025).

SWITZERLAND

Federal Office for the Environment, Switzerland, *SR 814.710: Ordinance on Protection from Non-Ionizing Radiation (ONIR)* (1999, revised 2023), https://www.fedlex.admin.ch/eli/cc/2000/38/de (only available in German, French, and Italian)

Exposure Limit on graph provided (W/m² @ 1800 MHz) = 0.1 (NISV Precaution)

On the following pdf, there is a table on page 15. Under the 1800 MHz at the top, drop down to Switzerland. They are listed as 6 V/m which is the equivalent of 0.1 W/m2

National Institute for Public Health and the Environment, *Comparison of international policies on electromagnetic fields (power frequency and radiofrequency fields)*, rivm.nl, https://www.rivm.nl/sites/default/files/2018-11/Comparison%20of%20international%20policies%20on%20electromagnetic%20fields%202018.pdf (last visited July 10, 2025).

See also RF Exposure from Mobile Phones, Towers, WiFi, Other RF, Magnetic Sciences, https://magneticsciences.com/RF-health/?srsltid=AfmBOopPbFd2RkhE7Z0xzD1mq1aBG1gl2ckuOPoaadN0qC4uODZOp0eV (last visited July 10, 2025).

Switzerland-Specific EMF Information: Body of European Regulators for Electronic Communications, *EMF related country-specific information for Switzerland*, berec.europa.gov, https://www.berec.europa.eu/en/tasks/electromagnetic-fields/emf-related-country-specific-information-for-switzerland (last visited July 10, 2025).

Limits:

- Public exposure limit: 4.5 W/m² at frequencies around 900 MHz
- Occupational exposure limits are higher depending on conditions
- Power Density: 0.1 W/m² (10 μW/cm²) in sensitive areas (e.g., homes, schools). 2–10 W/m² in other areas, aligned with ICNIRP guidelines.
- Specific Absorption Rate (SAR): 2 W/kg averaged over 10 g of tissue, per ICNIRP guidelines.

Access:

Switzerland's strict limits in sensitive areas, governed by the Ordinance on Protection from Non-Ionizing Radiation of 1999, reflect public concern and research into non-thermal effects. The FOEN provides public access to RF measurement data, and some cantons have imposed additional restrictions on 5G deployment due to health concerns. Compliance is ensured through regular environmental monitoring.

Citation:

Federal Office for the Environment, Switzerland, *SR 814.710: Ordinance on Protection from Non-Ionizing Radiation (ONIR)* (1999, revised 2023), https://www.fedlex.admin.ch/eli/cc/2000/38/de (only available in German, French, and Italian).