

20-1025 (Lead); 20-1138 (Consolidated)

**UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT**

ENVIRONMENTAL HEALTH TRUST; CONSUMERS FOR SAFE CELL
PHONES; ELIZABETH BARRIS; THEODORA SCARATO

CHILDREN'S HEALTH DEFENSE; MICHELE HERTZ; PETRA BROKKEN;
DR. DAVID O. CARPENTER; DR. PAUL DART; DR. TORIL H. JELTER; DR.
ANN LEE; VIRGINIA FARVER, JENNIFER BARAN; PAUL STANLEY, M.Ed.

Petitioners

v.

FEDERAL COMMUNICATIONS COMMISSION;
UNITED STATES OF AMERICA

Respondents

Petition for Review of Order Issued by the
Federal Communications Commission

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Edward B. Myers
Law Office of Edward B. Myers
14613 Dehaven Court
North Potomac, MD 20878
Phone: 717-752-2032
edwardbmyers@yahoo.com

Counsel for Petitioners 20-1025

Robert F. Kennedy, Jr.
Children's Health Defense
1227 North Peachtree Pkwy #202
Peachtree City, GA 30269
Phone: 845-377-0211
rfk.fcc@childrenshealthdefense.org

W. Scott McCollough
McCollough Law Firm, P.C.
2290 Gatlin Creek Rd.
Dripping Springs, TX 78620
Phone: 512-888-1112
wsmc@dotlaw.biz

Counsel for Petitioners 20-1138

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Notice of Proposed Rulemaking, and Memorandum Opinion
and Order, 34 FCC Rcd 11687 (2019)

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

In the Matter of)	
)	
Proposed Changes in the Commission's Rules)	ET Docket No. 03-137
Regarding Human Exposure to Radiofrequency)	(Terminated)
Electromagnetic Fields)	
)	
Reassessment of Federal Communications)	ET Docket No. 13-84
Commission Radiofrequency Exposure Limits and)	(Terminated)
Policies)	
)	
Targeted Changes to the Commission's Rules)	ET Docket No. 19-226
Regarding Human Exposure to Radiofrequency)	
Electromagnetic Fields)	

**RESOLUTION OF NOTICE OF INQUIRY,
SECOND REPORT AND ORDER,
NOTICE OF PROPOSED RULEMAKING,
AND
MEMORANDUM OPINION AND ORDER**

Adopted: November 27, 2019

Released: December 4, 2019

Comment Date: [30 days from publication in the Federal Register]

Reply Comment Date: [60 days from publication in the Federal Register]

By the Commission: Commissioner Rosenworcel concurring.

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I. INTRODUCTION

1. Modern communications technologies are an ever-increasingly critical part of our everyday lives and play a vital role in the execution of our businesses and daily affairs. The number and types of radiofrequency (RF) devices have proliferated, and the ways we interact with them are continuously changing. As a result, our environment is populated with RF sources, at times located in close proximity to humans. The National Environmental Policy Act of 1969 (NEPA) requires the Commission to evaluate the effects of our actions on the quality of the human environment, including human exposure to RF energy emitted by Commission-regulated transmitters and facilities.¹ The Commission has accordingly promulgated rules that set limits for RF exposure and, through the years, has created a framework to ensure compliance with these limits. Today, we take a number of steps regarding these limits to ensure the health and safety of workers and consumers of wireless technology, while also clarifying and streamlining rules to reduce regulatory burdens on licensees.

2. First, we resolve a *Notice of Inquiry* that sought public input on, among other issues, whether the Commission should amend its existing RF emission exposure limits.² After reviewing the extensive record submitted in response to that inquiry, we find no appropriate basis for and thus decline to propose amendments to our existing limits at this time. We take to heart the findings of the Food & Drug Administration (FDA), an expert agency regarding the health impacts of consumer products, that “[t]he

¹ National Environmental Policy Act of 1969, as amended, (NEPA) 42 U.S.C. §§ 4321-4335; *Proposed Changes in the Commission's Rules Regarding Human Exposure to Radiofrequency Electromagnetic Fields*, ET Docket No. 03-137, *First Report and Order*, *Further Notice of Proposed Rulemaking*, and *Notice of Inquiry*, 28 FCC Rcd 3498, 3503, para. 10 (2013) (hereinafter *2013 RF Order and Notice*); see also 47 CFR § 1.1307(b).

² See generally *infra* Section III.

weight of scientific evidence has not linked cell phones with any health problems.”³ Despite requests from some to increase and others to decrease the existing limits, we believe they reflect the best available information concerning safe levels of RF exposure for workers and members of the general public, including inputs from our sister federal agencies charged with regulating safety and health and from well-established international standards.

3. Second, based on our existing limits, we revise our implementing rules to reflect modern technology and today’s uses. We streamline our criteria for determining when a licensee is exempt from our RF exposure evaluation criteria, replacing our prior regime of service-based exemptions with a set of formulas for situations in which the risk of excessive RF exposure is minimal. For those licensees who do not qualify for an exemption, we provide more flexibility for licensees to establish compliance with our RF exposure limits. And we specify methods that RF equipment operators can use to mitigate the risk of excess exposure, both to members of the public and trained workers (such as training, supervision, and signage).

4. Third, we notice further targeted proposals on the application of our RF emission exposure limits for future uses of wireless technologies. Specifically, we propose to formalize an additional limit for localized RF exposure and the associated methodology for compliance for portable devices operating at high frequencies (gigahertz (GHz) frequencies). on top of our already existing limits that apply at these frequencies, and propose to extend this to terahertz (THz) frequencies as well⁴ We also propose to allow wireless power transfer (WPT) equipment under Part 15 and 18 of the Commission’s rules and propose specific exposure limits for such operations.

5. Fourth, and finally, we deny a pending petition for reconsideration and affirm our prior finding that the pinnae (outer ears) should be treated like other extremities for purposes of determining compliance with our RF emission exposure limits.

II. BACKGROUND

6. The Commission has the responsibility to set standards for RF emissions.⁵ The Commission has exercised that responsibility previously on multiple occasions. In a *Report and Order* adopted in 1996, the Commission last established a set of guidelines for evaluating the environmental

³ U.S. Food and Drug Administration, Do cell phones pose a health hazard?, <https://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/HomeBusinessandEntertainment/CellPhones/ucm116282.htm> (last updated Dec. 4, 2017).

⁴ The standards for localized specific absorption rate (SAR) that are normally applied for testing compliance of consumer devices operating below 6 GHz were derived from the Maximum Permissible Exposure (MPE) whole body limits that extend up to 100 GHz. The Commission currently employs a similar derivation to apply localized limits where appropriate for testing consumer devices operating above 6 GHz, and we propose in this item to formalize that approach.

⁵ NEPA, 42 U.S.C. §§ 4321-4335. The Commission’s authority to adopt and enforce RF exposure limits pursuant to the Communications Act and consistent with NEPA is well established. *See, e.g.*, Telecommunications Act of 1996, Pub. L. No. 104-104, § 704(b), 101 Stat. 56, 152 (directing Commission to “prescribe and make effective rules regarding the environmental effects of radio frequency emissions”); 47 U.S.C. § 332(c)(7)(B)(iv) (recognizing Commission’s predominant role in regulating RF emissions by proscribing state and local regulation of placement, construction, and modification of FCC-compliant personal wireless service facilities based on environmental effects of such RF emissions). *See also Robbins v. New Cingular Wireless LLC*, 854 F.3d 315, 319-20 (6th Cir. 2017) (“By delegating the task of setting RF-emissions levels to the FCC, Congress authorized the federal government—and not local governments—to strike the proper balance between protecting the public from RF-emissions exposure and promoting a robust telecommunications infrastructure.”); *Farina v. Nokia, Inc.*, 625 F.3d 97 (3d Cir. 2010) (FCC regulation of health effects of cell phone RF emissions preempted state lawsuit alleging adverse health effects from FCC-compliant cell phone RF emissions); *Cellular Phone Taskforce v. FCC*, 205 F.3d 82 (2d Cir. 2000) (Commission complied with NEPA in adopting RF emissions safety rules and properly preempted state or local regulation of RF emissions).

effects of RF exposure.⁶ These guidelines remain in effect today and include limits for specific absorption rate (SAR, the present metric for highly-localized, close-in exposure at commonly-used frequencies) and maximum permissible exposure (MPE, the measure for more-distant, whole-body exposure and for whole-body exposure at higher frequencies).⁷ The use of separate SAR and MPE standards, taken together, addresses limits for partial-body and whole-body exposures.⁸ In promulgating these guidelines, the Commission recognized that the potential for environmental impact from excluded devices was not significant,⁹ and established exemptions¹⁰ from the obligation to perform routine RF exposure evaluation for radio stations and existing facilities with technical characteristics that minimized, at that time, the likelihood of exceeding our limits.¹¹ The various exemptions were established over time based on assumptions about typical use particular to each service.¹²

⁶ *Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation*, ET Docket No. 93-62, *Report and Order*, 11 FCC Rcd 15123 (1996) (*1996 Order*). The Commission affirmed the *1996 Order* in its *Second Memorandum Opinion and Order. Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation et al.*, ET Docket Nos. 93-62 et al, *Second Memorandum Opinion and Order and Notice of Proposed Rule Making*, 12 FCC Rcd 13494 (1997) (*Second Memorandum Opinion and Order*).

⁷ The guidelines were based on criteria published by the National Council on Radiation Protection and Measurements (NCRP) and the American National Standards Institute/Institute of Electrical and Electronics Engineers, Inc. (ANSI/IEEE). The National Council on Radiation Protection and Measurements (NCRP), Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields, NCRP Report No. 86, Sections 17.4.1, 17.4.1.1, 17.4.2, 17.4.3 and 17.4.5 (1986) (NCRP Report No. 86). The NCRP is a nonprofit corporation chartered by Congress in 1964 primarily to collect, analyze, develop, and disseminate information on radiation protection. The American National Standards Institute (ANSI), IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, ANSI/IEEE Std C95.1-1992, Sections 4.1 and 4.2 (copyright IEEE 1992). The content of IEEE C95.1-1991 is equivalent to that of ANSI/IEEE C95.1-1992. IEEE is a non-profit international professional association of electrical and electronics engineers involved in technology standards development. ANSI is a private, not-for-profit organization that facilitates standards development.

⁸ See *1996 Order*, 11 FCC Rcd at 15123, para. 2 & n.3.

⁹ See 47 CFR § 1.1306. See also *Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation*, ET Docket No. 93-62, *Notice of Proposed Rulemaking*, 8 FCC Rcd 2849, para. 5 (1993).

¹⁰ As discussed in the *2013 RF Order and Notice*, and to avoid confusion in the NEPA context, we will use the term “exemption” (rather than “exclusion” or “categorical exclusion”) to refer to an exemption from the obligation to perform an RF exposure routine evaluation. *2013 RF Order and Notice*, 28 FCC Rcd at 3534-35, para. 113. By contrast, under NEPA and the Commission’s environmental rules, the term “categorical exclusion” refers to an exclusion of categories of actions from obligations to prepare an environmental assessment or other environmental evaluation. See 40 CFR § 1508.4; 47 CFR § 1.1306(a). The Commission’s categorical exclusions for actions that have no potentially significant environmental impact do not apply to actions that have specified impacts on certain natural resources or actions that result in human exposure to RF radiation in excess of applicable safety standards. See 47 CFR §§ 1.1306(b), 1.1307(a) & (b).

¹¹ These exemptions were modified in the 1997 *Second Memorandum Opinion and Order*, 12 FCC Rcd at 13509, para. 40. The Commission concluded that for mobile devices operating above 1.5 GHz with an effective radiated power of less than 3 watts, in addition to a similar provision for mobile devices operating below 1.5 GHz with an effective radiated power of less than 1.5 watts, the likelihood of exceeding established RF exposure limits was minimal. See *Second Memorandum Opinion and Order*, ET Docket 93-62, released August 25, 1997, FCC 97-303, 12 FCC Rcd at 13494 (1997).

¹² See, e.g., any item generally that introduces a new rule part or service, such as *Use of Spectrum Bands above 24 GHz for Mobile Radio Services*, Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd 8014, 8192, Appx. A (2016) (*2016 Spectrum Frontiers R&O and Further Notice*) or *Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, Report and Order and Second Further Notice of Proposed Rulemaking, 30 FCC Rcd 3959, 4095, Appx. A. In each case, 47 CFR § 1.1307 was amended to include exemptions for each new service.

7. In 2003, the Commission sought comment on exempting some transmitting antennas and devices from routine environmental evaluation for RF compliance and proposed to clarify the responsibilities of licensees and grantees and make the exemptions more practical, consistent, and efficient.¹³ To this end, the Commission made several proposals related to compliance with the human exposure limits for fixed, mobile, and portable transmitters.¹⁴ In 2013, the Commission addressed several of those proposals; specifically, it clarified procedures for evaluating whether a particular RF source would exceed the established exposure limits.¹⁵ The Commission also clarified references used to determine compliance with its limits, including making explicit that SAR limits predominate MPE limits as a compliance metric (although MPE limits are practical and may still be used as an alternative to demonstrate compliance in most cases), as well as treating the pinnae (outer ears) similarly to extremities of the body for purposes of determining exposure limits.¹⁶

8. In a 2013 Further Notice of Proposed Rulemaking, the Commission sought additional comment on changes to the compliance procedures to provide more efficient, practical, and consistent application of evaluation procedures and mitigation measures.¹⁷ The Commission proposed to define certain key terms and broadly revise and harmonize the criteria for determining whether single or multiple portable, mobile, or fixed RF sources¹⁸ are subject to routine evaluation for compliance with the RF exposure limits or are exempted from such evaluations.¹⁹ Additionally, the Commission proposed clarifications of evaluation requirements for portable and medical implant devices.²⁰ Further, the Commission proposed to adopt new requirements for signs and barriers at fixed transmitter sites.²¹ The Commission also proposed a clarification of the definition of and requirements for “transient exposure” to better ensure compliance with exposure limits.²² It also sought comment on establishing and clarifying who should bear responsibility for compliance with the RF emissions exposure requirements.²³

9. In 2013, the Commission inquired whether it should reevaluate its RF exposure limits and policies in light of recent scientific opinions, authoritative expert views, changes in RF devices, and/or the prevalence and usage patterns of RF devices.²⁴ In particular, the Commission asked whether these considerations warrant changes in the basic RF exposure limits, the RF evaluation procedures for devices, or the content and manner in which information regarding RF exposure by FCC-regulated devices are conveyed to the public.²⁵

¹³ *Proposed Changes in the Commission’s Rules Regarding Human Exposure to Radiofrequency Electromagnetic Fields*, ET Docket No. 03-137, Notice of Proposed Rule Making, 18 FCC Rcd 13187 (2003) (2003 RF NPRM).

¹⁴ *Id.* at 13189-206, paras. 6-49.

¹⁵ *See 2013 RF Order and Notice*, 28 FCC Rcd at 3500, para. 1.

¹⁶ *See id.* at 3505 *et. seq.*, paras. 14-107. As extremities, the pinnae – along with the hands, wrists, feet, and ankles – is subject to less stringent localized RF exposure limits than the rest of the body. *See id.* at 3514, paras. 42-50.

¹⁷ *2013 RF Order and Notice*, 28 FCC Rcd at 3533, paras. 108-09.

¹⁸ RF source is a more general term than transmitter or transmitting antenna and applies to Commission-regulated equipment and devices that may not be intentional transmitters but radiate RF energy. *See generally 2013 RF Order and Notice*, 28 FCC Rcd at 3549, *et. seq.*

¹⁹ *See 2013 RF Order and Notice*, 28 FCC Rcd at 3535, para. 114.

²⁰ *Id.* at 3555, para. 168.

²¹ *Id.* at 3560, para. 184.

²² *Id.* at 3557, para. 177.

²³ *Id.* at 3564, para. 193, at 3567-68, paras. 198, 199.

²⁴ *Id.* at 3570, para. 205-52.

²⁵ *Id.* at 3570, para. 205.

III. RESOLUTION OF NOTICE OF INQUIRY

10. We resolve and terminate the inquiry to review our RF exposure standards and certain related policies initiated in the *2013 RF Order and Notice*.²⁶ In the proceeding, the Commission solicited comment on a variety of issues, including RF exposure limits, consumer information, exposure reduction policies, emissions exposure evaluation, and proximity restrictions and disclosure requirements for portable RF sources.²⁷ Upon review of the record, we find no appropriate basis for and thus decline to initiate a rulemaking to reevaluate the existing RF exposure limits. This decision is supported by our expert sister agencies, and the lack of data in the record to support modifying our existing exposure limits. Specifically, no expert health agency expressed concern about the Commission's RF exposure limits. Rather, agencies' public statements continue to support the current limits. The Director of FDA's Center for Devices and Radiological Health advised the Commission, as recently as April 2019, that "no changes to the current standards are warranted at this time."²⁸ The record does not demonstrate that the science underpinning the current RF exposure limits is outdated or insufficient to protect human safety. Nor does the record include actionable alternatives or modifications to the current RF limits supported by scientifically rigorous data or analysis. For all these reasons, we terminate the inquiry, but will continue to study and review publicly available science and collaborate with other federal agencies and the international community to ensure our limits continue to reflect the latest science. If an appropriate basis for launching a new Commission proceeding arises, we are confident that the Commission will undertake further evaluation of our rules in light of that review.

11. Our existing exposure limits were adopted following recommendations from the U.S. Environmental Protection Agency (EPA), the Food and Drug Administration (FDA), and other federal health and safety agencies.²⁹ While research on the health effects of RF energy continues,³⁰ no evidence has moved our sister health and safety agencies to issue substantive policy recommendations for strengthening RF exposure regulation. Indeed, the FDA maintains that "[t]he weight of scientific

²⁶ See ET Docket No. 13-84.

²⁷ *2013 RF Order and Notice*, 28 FCC Rcd at 3574-89, paras. 216-52.

²⁸ See Letter from Jeffrey Shuren, M.D., J.D., Director, Center for Devices and Radiological Health, Food and Drug Administration, Department of Health and Human Services, to Julius Knapp, FCC, (dated April 24, 2019) (*FDA Letter*) at 2.

²⁹ *2013 RF Order and Notice*, 28 FCC Rcd at 3570, para. 205; *1996 Order*, 11 FCC Rcd at 15124, para 2.

³⁰ Since the release of the *2013 RF Order and Notice*, the World Health Organization (WHO) is in the process of revising its Environmental Health Criteria (EHC) on radiofrequency electromagnetic fields. The EHC summarizes the review of a panel of expert scientists concerning the physical characteristics of electromagnetic fields, as well as "measurement techniques, applications of electromagnetic fields and sources of exposure, mechanisms of interaction, biological effects, and guidance on the development of protective measures, such as regulations or safe-use guidelines," and it will be used as input by international standards bodies in their development of future guidelines limiting human exposure to radiofrequency energy. See http://www.who.int/peh-emf/research/rf_ehc_page/en/ ("The World Health Organization is undertaking a health risk assessment of radiofrequency electromagnetic fields, to be published as a monograph in the Environmental Health Criteria Series. This publication will complement the monographs on static fields (2006) and extremely low frequency fields (2007) and will update the monograph on radiofrequency fields (1993)."); see also 1993 WHO EHC 137 on RF-EMF (ISBN 92-4-157137-3), available at <http://www.inchem.org/documents/ehc/ehc/ehc137.htm>; National Toxicology Program, *Cell Phone Radiation Studies*, available at https://www.niehs.nih.gov/health/materials/cell_phone_radiofrequency_radiation_studies_508.pdf (NTP is collaborating with NIST and IT'IS to develop additional short-term measurement techniques and studies to investigate so that future shorter term studies can be conducted to evaluate different RFR frequencies and modulations reflecting the changing technologies in the telecommunications industry.) (Nov. 2018).

evidence has not linked cell phones with any health problems”³¹ and that “the current safety limits for cell phones are acceptable for protecting the public health.”³² Accordingly, it is imprudent to revise these scientifically accepted recommendations without appropriate evidence supporting such a change,³³ especially when the FDA itself has found no evidence to support any revisions.³⁴ We take our duty to protect the public from any potential harm due to RF exposure seriously. Indeed, as noted in the inquiry,

³¹ U.S. Food and Drug Administration, Do cell phones pose a health hazard? (“The weight of scientific evidence has not linked cell phones with any health problems.”), <https://www.fda.gov/radiation-emitting-products/cell-phones/health-issues> (last updated Dec. 4, 2017).

³² *Statement from Jeffrey Shuren, M.D., J.D., director of the FDA’s Center for Devices and Radiological Health on the recent National Toxicology Program draft report on radiofrequency energy exposure* (Feb. 2, 2018), <https://www.fda.gov/news-events/press-announcements/statement-jeffrey-shuren-md-jd-director-fdas-center-devices-and-radiological-health-recent-national>.

³³ The National Toxicology Program (NTP) of the U.S. Department of Health and Human Services has released final reports of its findings, stating that its study found increases in the incidences of malignant schwannoma in the hearts of male rats exposed to cell phone radiation. <https://ntp.niehs.nih.gov/results/areas/cellphones/index.html> (last updated May 7, 2019) (NTP Animal Studies). Another animal study was conducted by the Ramazzini Institute published in *Environmental Research* reporting results of research involving 1.8 GHz RF exposure in rats, in *Report of final results regarding brain and heart tumors in Sprague-Dawley rats exposed from prenatal life until natural death to mobile phone radiofrequency field representative of a 1.8 GHz GSM base station environmental emission*, 165 *Environmental Research* 496-503 (pub. Aug. 2018), available at <https://www.sciencedirect.com/science/article/pii/S0013935118300367> (Ramazzini Study). NTP has not suggested in its findings what this research may mean relative to human beings, including anything that would help to indicate appropriate exposure levels, and its research work is ongoing at this time. In particular, John Bucher, an NTP senior scientist, stated that “[t]he exposures used in the studies cannot be compared directly to the exposure that humans experience when using a cell phone.” National Institute of Environmental Health Sciences, High Exposure to Radio Frequency Radiation Associated with Cancer in Male Rats (Nov. 1, 2018). Dr. Bucher suggested that the results cannot be extrapolated to humans because (1) the rats and mice received RF radiation across their whole bodies; (2) the exposure levels were higher than what people receive under the current rules; (3) the duration of exposure was longer than what people receive; and (4) the studies were based on 2G and 3G phones and did not study WiFi or 5G. <https://www.niehs.nih.gov/news/newsroom/releases/2018/november1/index.cfm> (November 1, 2018). Additionally, FDA officials reviewing this research also note that “based on our ongoing evaluation of this issue and taking into account all available scientific evidence we have received, we have not found sufficient evidence that there are adverse health effects in humans caused by exposures at or under the current radiofrequency energy exposure limits.” See *Statement from Jeffrey Shuren, M.D., J.D., director of the FDA’s Center for Devices and Radiological Health on the recent National Toxicology Program draft report on radiofrequency energy exposure* (Feb. 2, 2018), <https://www.fda.gov/news-events/press-announcements/statement-jeffrey-shuren-md-jd-director-fdas-center-devices-and-radiological-health-recent-national>; *id.* (“Even with frequent daily use by the vast majority of adults, we have not seen an increase in events like brain tumors. Based on this current information, we believe the current safety limits for cell phones are acceptable for protecting the public health.”).

³⁴ See Letter from Jeffrey Shuren, M.D., J.D., Director, Center for Devices and Radiological Health, Food and Drug Administration, Department of Health and Human Services, to Julius Knapp, FCC, (dated April 24, 2019) (*FDA Letter*) at 2 (“NTP’s experimental findings should not be applied to human cell phone usage, the available scientific evidence to date does not support adverse health effects in humans due to exposures at or under the current limits, and the FDA is committed to protecting public health and continues its review of the many sources of scientific literature on this topic.”). ICNIRP discussing both the NTP Animal Studies and the Ramazzini Study concluded that “these studies do not provide a reliable basis for revising the existing radiofrequency exposure guidelines” and noted various inconsistencies, limitations, and further need to review the application of animal studies to human carcinogenicity research that affect the usefulness of the studies in setting exposure guidelines. International Commission on Non-Ionizing Radiation Protection, *ICNIRP Note on Recent Animal Carcinogenesis Studies*, Munich, Germany (Apr. 9, 2018), <https://www.icnirp.org/cms/upload/publications/ICNIRPnote2018.pdf> (summarizing the studies and providing initial conclusions).

our limits for devices held close to the body are more restrictive than other more recently published international limits.³⁵

12. In the inquiry, we sought comment to determine whether our general rules and regulations limiting RF exposure are still appropriately drawn.³⁶ Over 1,000 comments or ex parte presentations were filed in the proceeding. The vast majority of filings were unscientific, and even the filings that sought to present scientific evidence failed to make a persuasive case for revisiting our existing RF limits. While the record includes some research information, there is no persuasive case in the record to evaluate the quality and significance of that research. Nor do cases advocating alternatives in the record provide sufficient scientific evidence or explanation justifying why the proposed reductions are the appropriate value(s), or how they might affect the viability or performance of wireless services and devices. In other words, while the record includes scientific papers of variable quality and significance that allude to more restrictive RF exposure limits under certain circumstances, they fail to provide any specific, pragmatic recommendation for how our RF exposure limits could be adjusted as a result of this research.³⁷ The *Inquiry* requested comment on whether any general technical approach to reduce exposure below our limits in some situations is appropriate or feasible, particularly in cases in which there is no specific quantitative goal for improvement.³⁸ Commenters that provided scientific articles did not answer our request for a specific, quantitative goal but many provided descriptive references to the BioInitiative Report and Building Biology, which specify extremely low limits (0.3-0.6 nW/m² and 0.1 µW/m², respectively) for RF energy exposure—limits that are millions to billions times more restrictive than FCC limits.³⁹ No device could reliably transmit any usable level of energy by today's technological standards while meeting those limits.⁴⁰ Further, there is no scientific evidence in the record that such restrictive limits would produce any tangible benefit to human health, or provide any improvement over current protections against established risks.⁴¹ Moreover as noted by the FDA, there is no evidence to support that adverse health effects in humans are caused by exposures at, under, or even in

³⁵ See 2013 RF Order and Notice, 28 FCC Rcd at 3572-73, 3575-76, paras. 213, 220. IEEE Std C95.1-2005 and the ICNIRP HF Guidelines establish localized SAR limits of 2.0 W/kg averaged over 10 grams of tissue as opposed to our existing localized SAR limit of 1.6 W/kg averaged over 1 gram. *Id.* at 3573, para. 213. Applying this approach, a larger averaging volume of similar shape would permit a higher spatial peak field in a small area of that mass, as there is more non-peak-exposed mass considered in the averaging. Therefore, based on the application of this approach, the spatial peak exposure in a 10-gram cube as would be measured for compliance in any other more recently adopted international limits is likely more than the spatial peak exposure in a 1-gram cube for the same averaged SAR value specified in our rules.

³⁶ 2013 RF Order and Notice, 28 FCC Rcd at 3570-71, paras. 205-10. We also noted the recommendation of the United States Government Accountability Office (GAO) in a report to Congress that the Commission formally reassess its current RF energy exposure limit, including the effects on human health and that it solicit the opinions of relevant health and safety agencies in deciding whether any change in the current RF energy exposure limit is appropriate. *Id.* at 3570, para. 206 (citing United States Government Accountability Office, Report to Congressional Requesters, *TELECOMMUNICATIONS: Exposure and Testing for Mobile Phones Should Be Reassessed*, GAO-12-771 (July 2012)).

³⁷ *Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation*, Second Memorandum Opinion and Order and Notice of Proposed Rulemaking, 12 FCC Rcd 13494, 13505, para. 31 (1997).

³⁸ 2013 RF Order and Notice, 28 FCC Rcd at 3583, para. 238.

³⁹ See BioInitiative Working Group, BioInitiative 2012 Report (2012), <https://www.bioinitiative.org/table-of-contents>; BAUBIOLOGIE MAES / Institut für Baubiologie + Ökologie IBN, Standard of Building Biology Testing Methods, SBM-2008 (2008), <https://www.baubiologie.de/downloads/building-biology-guidelines-english.pdf>.

⁴⁰ See MWF Reply at 6 (noting that the BioInitiative Reports' suggested limits would result in compliance zones around base station sites that would extend several kilometers for a macro base station).

⁴¹ 2013 RF Order and Notice, 28 FCC Rcd at 3584, para. 240.

some cases above, the current RF limits.⁴² Indeed, no scientific evidence establishes a causal link between wireless device use and cancer or other illnesses.⁴³

13. While some commenters seek Commission action to tighten RF exposure standards, others suggest that the Commission should revise its RF exposure standards to be consistent with less-restrictive international standards, like the IEEE or the ICNIRP RF standard.⁴⁴ For similar reasons that we decline to make changes that would tighten the current standard, we decline to make any changes that would effectively relax our current standard.⁴⁵ Accordingly, we conclude that the best available evidence, including our consideration of the opinions provided by our expert sister agencies, supports maintaining our current RF exposure standards.

14. We also decline to revisit our RF exposure evaluation procedures for consumer portable devices, especially phones. Current evaluation procedures require consumer portable devices to be tested at maximum power under normal use conditions. For phones testing is performed against the head, representing normal use during a phone call, and at a separation distance of up to 2.5 centimeters (about

⁴² See Statement from Jeffrey Shuren, M.D., J.D., director of the FDA's Center for Devices and Radiological Health on the recent National Toxicology Program draft report on radiofrequency energy exposure (Feb. 2, 2018), <https://www.fda.gov/news-events/press-announcements/statement-jeffrey-shuren-md-jd-director-fdas-center-devices-and-radiological-health-national>; *id.* ("We ... must thoroughly evaluate and take into consideration the totality of the data, and do so within the context of the complete body of evidence rather than drawing conclusions from the results of a single study. As part of our commitment to protecting the public health, the FDA has reviewed, and will continue to review, many sources of scientific and medical evidence related to the possibility of adverse health effects from radiofrequency energy exposure in both humans and animals and will continue to do so as new scientific data are published. Based on our ongoing evaluation of this issue, the totality of the available scientific evidence continues to not support adverse health effects in humans caused by exposures at or under the current radiofrequency energy exposure limits. We believe the existing safety limits for cell phones remain acceptable for protecting the public health.")

⁴³ FCC, Wireless Devices and Health Concerns (Aug. 6, 2018), <https://www.fcc.gov/consumers/guides/wireless-devices-and-health-concerns>.

⁴⁴ Institute of Electrical and Electronics Engineers, Inc. (IEEE Std C95.1-2005), *IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*, IEEE Std C95.1-2005, copyright 2006 by the Institute of Electrical and Electronics Engineers, Inc. (IEEE), New York, New York 10016-5997; International Commission on Non-Ionizing Radiation Protection (ICNIRP HF Guidelines), *Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (Up to 300 GHz)*, Health Physics 74 (4): 494-522, 1998. ICNIRP is an international non-profit organization comprised of independent scientific experts that provides scientific advice and guidance on the health and environmental effects of non-ionizing radiation (NIR) to protect people and the environment from detrimental NIR exposure.

⁴⁵ See International Commission on Non-Ionizing Radiation Protection (ICNIRP), *Draft ICNIRP Guidelines, Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic and Electromagnetic Fields (100 kHz TO 300 GHz)*, Appx. A: Review of Studies on Dosimetry, section 3.3.2 ("Spatial averaging considerations") at 10, https://www.icnirp.org/cms/upload/consultation_upload/ICNIRP_RF_Guidelines_PCD_Appx._A_2018_07_11.pdf (July 11, 2018).; See also Institute of Electrical and Electronics Engineers, Inc. (IEEE Std C95.1-2019), *IEEE Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz*, IEEE Std C95.1-2019, copyright 2019 by the Institute of Electrical and Electronics Engineers, Inc. (IEEE), New York, New York 10016-5997, https://standards.ieee.org/standard/C95_1-2019.html (October 4, 2019). We observe that this standard is intended for RF protection of military personnel, and while our intent is to protect the broader public, these standards can be illuminating in that regard. See IEEE Std C95.1-2345-2014 - IEEE Standard for Military Workplaces--Force Health Protection Regarding Personnel Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz (May 30, 2014), <http://standards.ieee.org/findstds/standard/C95.1-2345-2014.html>.

one inch) from the body to represent phone use in other ways.⁴⁶ Even though some parties claim that the RF exposure evaluation procedures for phones should require testing with a “zero” spacing – against the body – this is unnecessary. First, phones are tested against the head without any separation distance to represent normal use conditions during a phone call. Second, at maximum power, even though they are not consistently operated at such power levels. This means that testing is performed under more extreme conditions than a user would normally encounter, so any potential dangers at zero-space would be mitigated.⁴⁷ Third, actual testing separation distances tend to be less than the 2.5 cm prescribed for many devices. For example, phones with tethering capabilities (*i.e.*, “hotspot mode”) are tested at a maximum separation distance from the human body of 1 cm.⁴⁸ Fourth, our existing exposure limits are set with a large safety margin, well below the threshold for unacceptable rises in human tissue temperature. Thus, even if certified or otherwise authorized devices produce RF exposure levels in excess of Commission limits under normal use, such exposure would still be well below levels considered to be dangerous, and therefore phones legally sold in the United States pose no health risks.⁴⁹

15. We further decline to revisit our RF exposure policy as it pertains to children. Under IEEE Std 1528-2003—the standard for determining the compliance of devices such as cell phones—the measurement test setup that is used was designed to test for effects on children as well as adults.⁵⁰ Similarly the FDA maintains that “[t]he scientific evidence does not show a danger to any users of cell phones from RF exposure, including children and teenagers.”⁵¹ Since the inquiry, scientific debate has continued about whether either dosimetric (*e.g.*, higher conductivity of skull and brain tissues in children’s heads) or anatomical differences (*e.g.*, characteristically smaller sized heads and outer ears) in children could result in unacceptably high exposures depending on use conditions.⁵² While we agree that there are differences in actual exposure in real human heads,⁵³ and acknowledge that possible age-related

⁴⁶ KDB Publication 447498 D01, “RF Exposure Procedures and Equipment Authorization Policies for Mobile and Portable Devices.” See FCC Office of Engineering and Technology, Laboratory Division, Knowledge Database, <https://apps.fcc.gov/oetcf/kdb/>.

⁴⁷ Further, certain manufacturers design their phones to include features like proximity sensors, which reduce power when close to a user’s body, to ensure that they are compliant even if the phones are used in a nonconforming manner, and any potential dangers at zero-space would be detected anyway. Other manufacturers have changed device form factors, including antenna design, to ensure reduced RF exposure to the user. Power control and discontinuous transmission on the devices assures that devices operate well below maximum power for the vast majority of the time, and hence result in lower RF exposure. See Nokia Comments at 17; MWF Comments at 7.

⁴⁸ KDB Publication 941225 D06, “SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities” (Oct. 2015). See FCC Office of Engineering and Technology, Laboratory Division, Knowledge Database, <https://apps.fcc.gov/oetcf/kdb/>.

⁴⁹ We note that any claim as to the adequacy of the FCC required testing, certification, and authorization regime is no different than a challenge to the adequacy of the federal RF exposure limits themselves. Both types of claims would undermine the FCC’s substantive policy determinations.

⁵⁰ See *IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques*, IEEE Std 1528-2003 (the test setup represents a conservative case “for men, women, and children” alike).

⁵¹ See <https://www.fda.gov/radiation-emitting-products/cell-phones/children-and-cell-phones>.

⁵² See, *e.g.*, Foster, K. R. and Chou, C.-K., *Are Children More Exposed to Radio Frequency Energy from Mobile Phones than Adults?*, IEEE Access, vol. 2, pp. 1497-1509, Dec. 2014; Gandhi, O. P., *Yes the Children Are More Exposed to Radiofrequency Energy from Mobile Telephones Than Adults*, IEEE Access, vol. 3, pp. 985-988, June 2015.

⁵³ SAR quantities in actual human heads do not vary as they do in homogeneous liquids that are used for standardized compliance testing, but the properties of those liquids were chosen to conservatively represent the heterogeneous tissues in real human heads, including age variation.

differences in absorption of RF energy in the heads of mobile phone users could result in differences in exposure to the head, these considerations were appropriately taken into account and incorporated into the measurement standards.⁵⁴ Therefore, based on the evidentiary record, we see no reason to revisit our equipment authorization procedures as a result.

16. We also continue to ensure that relevant information is made available to the public. First, the Commission maintains several webpages that provide information about RF exposure to the public. These range from general RF exposure information to information on specific topics, including wireless devices and health concerns.⁵⁵ Second, guidance from the FCC Laboratory continue recommending that device manuals include operating instructions and advisory statements for RF exposure compliance.⁵⁶ This information allows users to make informed decisions on the type of body-worn accessories and operating configurations that are appropriate for their usage. Third, we make available information on the characterization of typical RF exposure levels emitted from base stations. Relatedly, we note that the World Health Organization (WHO) states that “[f]rom all evidence accumulated so far, no adverse short-or long-term health effects have been shown to occur from the RF signals produced by base stations.”⁵⁷ WHO goes on to say that the erroneous public perception of a possible risk from such exposure may, even while unsupported by evidence, still contribute to a feeling of uncertainty or a lack of control. That is why the context and placement of RF exposure information is so important. Given the federal safety determination, the information on the FCC’s websites and in device manuals are both adequate to inform consumers of these issues and do not risk contributing to an erroneous public perception or overwarning of RF emissions from FCC certified or authorized devices. The FCC will continue to evaluate public information materials and update as appropriate.

I. SECOND REPORT AND ORDER

17. This *Second Report and Order* revises the rules regarding the two methods of complying with our RF exposure limits: *exemption*—consideration of whether a particular device or deployment is so clearly compliant with our rules that it qualifies as exempt from the requirement to undertake a more thorough analysis; and *evaluation*—a more specific examination of an individual site or device, which considers factors beyond those used for exemption for less obvious cases and may be performed with a variety of computation and/or measurement methodologies.⁵⁸ In addition, we discuss *mitigation*—the

⁵⁴ See Beard, B., et al., *Comparisons of Computed Mobile Phone Induced SAR in the SAM Phantom to That in Anatomically Correct Models of the Human Head*, IEEE Trans. on Electromagnetic Compatibility, Vol. 48, No. 2, pp. 397–407 (May 2006). See also Christ, A., et. al., *Age-Dependent Tissue-Specific Exposure of Cell Phone Users*, Phys. Med. Biol., vol. 55, pp. 1767–1783 (Mar. 2010). See also Hadjem A., et. al., *Analysis of Power Absorbed by Children’s Head as a Result of New Usages of Mobile Phones*, IEEE Trans. Electromagnetic Compatibility, Vol. 52, No. 4, pp. 812–819 (Nov. 2010).

⁵⁵ See <https://www.fcc.gov/consumers/guides/wireless-devices-and-health-concerns>. See also <https://www.fda.gov/radiation-emitting-products/cell-phones/reducing-exposure-hands-free-kits-and-other-accessories>.

⁵⁶ The Commission does not endorse the need to take measures to further reduce exposure to RF energy. However, for any consumers who are skeptical of the science and/or the analysis that underlies the Commission’s RF exposure guidelines, the Commission provides information on simple steps that you can take to reduce your exposure to RF energy from wireless phones. See FCC, Consumer and Governmental Affairs Bureau, Wireless Devices and Health Concerns, Consumer Guide, <https://www.fcc.gov/consumers/guides/wireless-devices-and-health-concerns>.

⁵⁷ <https://www.who.int/peh-emf/publications/facts/fs304/en/>

⁵⁸ We reiterate that regardless of whether a site is exempt from RF exposure routine evaluation, licensees are responsible for a device’s or transmitter’s compliance with our RF exposure limits. See 47 CFR § 1.1307(b)(1), (b)(2)(v), (b)(3)(i), (ii). In the event that RF levels would result in human exposure in excess of our limits, a formal Environmental Assessment must be conducted to initiate processing under NEPA to determine whether it presents a

(continued....)

measures taken to restrict or limit RF exposure, for example in controlled areas, to keep exposure within our limits. We emphasize that this *Second Report and Order* makes no changes to the existing limits for RF exposure. The new methods that we adopt herein only affect how parties determine and demonstrate that they are in compliance with those standards.

18. The new rules we adopt are consistent with general engineering principles and the exposure limits themselves. The level of exposure is a function of the power and frequency of the RF transmission, a person's distance from the source, and the duration of the exposure. The new rules account for these variables, permitting a more streamlined exemption process in low-exposure situations (low power, relatively large distance between the source and a person's body, and/or short duration), while requiring a more thorough evaluation in potentially higher-exposure situations (higher power, smaller distance between the source and a person's body, and/or longer duration). Our rules also reflect that more restrictive limits are appropriate for the general public than for those persons (typically workers) who are trained to understand the need to limit their exposure and have the knowledge and capability to do so.

19. This *Second Report and Order* proceeds in three parts. First, we address the exemptions from the RF evaluation requirement, identifying broad criteria that apply to single and multiple RF sources based on power, distance, and frequency, irrespective of service classifications. The Office of Engineering and Technology (OET)⁵⁹ will offer more detailed case-specific guidance as needed through the Knowledge Database (KDB), as well as through technical bulletins and supplements, such as OET Bulletin 65.⁶⁰ Second, we clarify the calculation or measurement methodologies that should be used, in cases where no exemption applies, to determine potential RF exposure levels in the RF evaluation process. In the third and final section, we address post-evaluation mitigation procedures, like access, signage, and training, to ensure that persons—both the general public and trained personnel—are not exposed to RF emissions in excess of our established exposure limits. The new rules clarify the obligations of licensees to provide safety training to workers and to supervise any members of the general public (including untrained workers) who are permitted to enter a restricted area.

A. Exemptions from the RF Exposure Evaluation Requirement

20. We adopt the proposals in the *2013 RF Further Notice* to revise the various specific criteria that governed the exemptions from our RF evaluation requirements in favor of a single, generally-

(Continued from previous page) _____

hazard to humans irrespective of its noncompliance with our exposure limits. See 42 U.S.C. §§ 4321-4335. To date, no applicant or licensee has submitted an Environmental Assessment for RF exposure to the Commission.

⁵⁹ OET has developed a substantial body of guidance that is available via public notices, frequently asked questions (FAQs), and specific process guidance, all of which is compiled in our online Knowledge Database (KDB). See FCC Office of Engineering and Technology, Laboratory Division, Knowledge Database, <https://apps.fcc.gov/oetcf/kdb/>. Equipment authorization topics that relate to new services and devices authorized by the Commission are often addressed in the KDB. This includes, for example, simple answers to questions, guidance on how to file for authorization of new types of devices, and guidance on how to conduct compliance testing. The staff guidance provided in the KDB is non-binding and is intended to assist the public in following Commission requirements.

⁶⁰ FCC Office of Engineering and Technology, Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields, OET Bulletin 65, Edition 97-01 (1997) (OET Bulletin 65). OET Bulletin 65 provides guidance in determining whether proposed or existing transmitting facilities or operations comply with FCC rules limiting human exposure to RF energy. *Id.* at 1. Supplements A and B to OET Bulletin 65 provide specialized guidance for specific services—broadcasting and amateur radio, respectively—in their compliance determinations.

applicable set of formulas for both single and multiple sources of RF emissions based on power, distance, and frequency of fixed, mobile, and portable transmitters.⁶¹

21. The rules we adopt replace a patchwork of outdated and inconsistent rules. Specifically, the old rules are outdated because they were developed before the more recent proliferation of RF sources, particularly fixed RF antennas now commonly found on rooftops, lampposts, and other places not previously used for such applications.⁶² The old rules also are inconsistent because they exempt transmitters from evaluation for compliance with the RF limits depending on the service they offer and certain technical characteristics, typically power and/or height.⁶³ Those rules incorporate various assumptions that result in dissimilar requirements for similar services. For example, a Part 101 transmitter and a Part 30 transmitter both using millimeter wave spectrum, with similar antenna gain and transmitter power, are treated differently under the old rules—while the Part 30 transmitter requires an evaluation, the Part 101 does not.⁶⁴ Further, the old rules treat certain RF transmitters—like ship earth station transmitters under Part 80—as requiring evaluation regardless of technical characteristics,⁶⁵ while there are whole categories of transmitters—like Part 90 transmitters that do not fall under subparts P or S—that are exempt.⁶⁶ As a result, while certain classes of RF transmitters were categorically subject to evaluation, others were not, without a consistent rationale.⁶⁷

22. The new exemption criteria apply to all of our rules authorizing RF sources.⁶⁸ Specifically, we create three broad classes of RF exemptions: (i) for extremely low-power devices that transmit at no more than 1 mW; (ii) for somewhat higher-power devices with transmitting antennas that operate within 40 cm of the body, a formula based primarily on the localized specific absorption rate (SAR) limits; and (iii) for all other transmitters based on a set of formulas for the maximum permissible exposure (MPE) limits. For each class, we provide for both the single-transmitter case and the multiple-

⁶¹ See 2013 RF Order and Notice, 28 FCC Rcd at 3537-38, para. 119. The Commission also proposed using the term “exemption” (as opposed to “exclusion”) for this topic and proposed a set of technical definitions related to output power and separation distance. *Id.* at 3534-35, para. 113. No commenting party opposed the terminology or the definitions and we adopt them as shown in the Final Rules. See *infra* Appx. A. A list of commenters to the 2013 RF Order and Notice appears in Appx. E.

⁶² See 47 CFR § 1.1307(b)(1), tbl. 1, (b)(2).

⁶³ *Id.* For example, the old rules determined an exemption depending whether a transmitter was above an ERP threshold depending on which service rules applied, and how the transmitter was installed (*e.g.*, 10 meters above ground, building-mounted, *etc.*) rather than distance from human presence. See *id.*

⁶⁴ Transmitters in the relevant subparts of Part 101 are exempt if building-mounted and their EIRP is less than 1640 watts, while all transmitters mounted on buildings operating under Part 30 must be evaluated. See 47 CFR § 1.1307(b)(1), tbl. 1.

⁶⁵ *Id.* The rule presumes that all transmitters on ships operating under Part 80 are not exempt regardless of how they are installed and, by a lack of inclusion in the table, simultaneously presumes that all non-ship transmitters are exempt. *Id.* Similarly, Satellite Communications Services (part 25), Radio Broadcast Services (part 73), and 76-81 GHz Radar Service (part 95): “Evaluation is required if . . . [a]ll included.” *Id.* On the other hand, services not listed in the Table are not required to be evaluated. See *id.* § 1.1307(b)(1) “[E]xposure limits in §§ 1.1310 and 2.1093 of this chapter are generally applicable to all facilities . . .”).

⁶⁶ The language in the rule stating that “[e]valuation required if” certain conditions exist for the enumerated services serves to exclude other conditions and categories of transmitters. See *id.*

⁶⁷ *Id.* § 1.1307(b)(1), tbl. 1. For example, Table 1 indicates that building-mounted antennas with effective radiated powers as high as 2,000 watts are not required to be evaluated, depending on the applicable service rules, regardless of how far a distance these transmitters are separated from areas where persons can access. *Id.* Effective radiated powers this high could be noncompliant at short distances (*e.g.*, ten meters as described in other parts of the Table) if not appropriately installed. *Id.*

⁶⁸ See *infra* Appx. A, Amended Rule 47 CFR § 1.1307(b)(1).

transmitter case. If the device or transmitter falls under one of these classes of RF exemptions, no additional action is necessary. If, on the other hand, the device or transmitter does not fall under one of these exemptions, the applicant or licensee will have to perform a routine RF evaluation to determine compliance with the exposure limits. Under the new rules, every applicant for equipment authorization and every licensee prior to deployment or commencement of operations seeking to be exempt will use the calculations in our rules to determine whether the device or transmitter falls under one of the three classes of exemptions.⁶⁹ If the applicant or licensee does not fall under one of the exemptions, it must perform a routine evaluation to determine compliance with our RF exposure rules.

23. The new rules do not impose any significant burdens on the impacted parties because the underlying exposure rules have not changed and the parties' obligations to comply with the RF exposure limits remain the same. The principal difference between the new exemptions and the old rules is the uniform consideration of the distance between the RF source and the location where a human could potentially experience exposure (i.e., separation distance), rather than wholesale exemption of service classes or operational presumptions.⁷⁰ We anticipate that in the vast majority of situations the transmitting antennas installed at stations used by the various services are separated from the public by distances greater than those specified in the new rules. In such cases, no further action will be necessary. For example, microwave stations operating under Part 101 of the rules were subject to the RF exposure limits but did not require routine evaluation. These stations operate on towers that are separated from the public by a distance greater than required for evaluation. On the other hand, if a transmitting antenna is located near to the ground and closer to the public than the specified distance, it would be appropriate for that station to be evaluated.⁷¹ In sum, we expect that if an RF source was "categorically excluded" or "exempt" from routine evaluation under the old rules, it will most likely still be exempt from routine evaluation under the rules we adopt today.⁷²

24. For those relatively few instances where an evaluation may be required under the new rules, we expect this will be fairly straightforward. The calculations require only information that the applicants already have on hand, notably the operating frequency and effective radiated power. For the most part, these calculations will result in conclusions that are similar to our old rules. . We note that this information is not required to be routinely filed with the FCC. Further, to ease the transition to the new rules, we establish a transition period below to allow licensees and manufacturers an opportunity to determine whether they meet the criteria for an exemption.⁷³

⁶⁹ See *infra* Appx. A, Amended Rule 47 CFR § 1.1307(b)(2)(i)-(ii).

⁷⁰ See 47 CFR § 1.1307(b)(1), tbl. 1. Where previously applicants would compare the operating frequency specified, the maximum effective radiated power (ERP), and considerations including how high antennas are above ground or where they are intended to be mounted (*e.g.*, on a building) to identify any possible exemption from evaluation provided for their particular service in the table, now the applicants will determine whether they are exempt based on the applicant's operating frequency, maximum ERP, and separation distance regardless of service type.

⁷¹ Separation distance can be ascertained when installers visit the transmitter site to install equipment prior to operation. See *generally* 47 CFR § 1.1307(b) regarding ongoing compliance expectations for all facilities, operations, and transmitters regulated by the Commission. But see Whedbee Comments at 3-9 (raising concerns about definitions of terms. We observe that separation distance is well-defined in relation to the radiating structure (*i.e.*, antenna) and any part of the human body, and that by convention antenna efficiency is taken into account in antenna gain ($G = \eta D$) used to determine ERP).

⁷² The new exemption criteria will permit up to 1 kW ERP for a wireless base station operating at 850 MHz, or up to 2 kW ERP for a wireless base station operating at 1900 MHz, each separated by approximately ten meters to be exempt from evaluation, which is similar to what Table 1 presently allows. See 47 CFR § 1.1307(b)(1). Additionally, low-power broadcast stations operating at less than 100 W ERP would continue to be exempt if separated by at least five meters. See *id.*

⁷³ See *infra*, Section IV.C, paras. 108-10.

25. The proposals we adopt today received substantial support from commenters. The IT'IS Foundation, for example, supported the new exemption standards outright.⁷⁴ There were also several commenters, including WIA, Verizon, and AT&T, who provided qualified support for the proposal, favoring the Commission's general approach to the issue, but voicing concerns over the loss of existing exemptions.⁷⁵ Opposition to the proposal came primarily from parties that objected to the loss of service-based exemptions—Part 90 licensees, Part 101 licensees, and amateur radio operators—and claimed the changes would be unnecessary or burdensome.⁷⁶ Part 90 Private Users contend that the uniform application of the proposed exemptions would increase financial burdens on licensees that are not in the business of providing radio communications and do not control all of their antenna sites,⁷⁷ because it would require them to review each antenna site and verify adequate separation distances, even though there is no evidence in the record of non-compliance with the RF exposure limits.⁷⁸ Similarly, the Fixed Wireless Communications Coalition, Inc. (FWCC), representing the interests of terrestrial fixed microwave communications, argues that the proposals will require at least a preliminary calculation for every facility and that an “anomaly” in the exemption would require many installations to undergo further evaluation.⁷⁹ UTC also opposes the elimination of the existing exemptions by service for Part 90 and Part 101 because the antennas deployed for these services are typically mounted on structures with limited access and “generally do not pose a significant risk of exceeding the Commission's RF exposure limits.”⁸⁰

26. We note that RF exposure compliance requirements have been generally applicable to all facilities, operations, and transmitters regulated by the Commission. We recognize that the majority of the RF sources deployed by these parties and their members are mounted on towers or other structures well above ground with limited access. However, much has changed since the time exemption from RF evaluation of microwave installations on towers was first established. Fixed services are now often used for backhaul for wireless communications and can be located on publicly accessible rooftops and structures near ground level that are not necessarily spatially removed from publicly accessible areas at

⁷⁴ See IT'IS Foundation Comments at 3 (supports the exemptions as proposed).

⁷⁵ See WIA, formerly PCIA – The Wireless Infrastructure Association and The HetNet Forum (PCIA) Comments at 4-5; WIA Reply at 2-3 (generally supporting the proposed approach but argues proposed exemption criteria are needlessly restrictive); Verizon Comments at 3-4 (proposing a modified exemption formula, concerned that the proposed exemption criteria would result in network facilities losing their exempt status, including small cell and distributed antenna system (DAS) transmitters); AT&T Reply at 4-6 (acknowledging the benefit of streamlining the Commission's exemption rules, but supports the continued exemption of Part 101 microwave facilities).

⁷⁶ See CTIA Reply at 33-35 (echoing Verizon's concern, arguing that small cell sites “qualify as a case that presents little to no risk”); Private Users Comments at 2-4; FWCC Comments at 2-5; UTC Reply at 1, 3-7; AICC Reply at 1, 10, 14 (arguing to retain the existing service-based exemption for Part 90 Private Land Mobile Radio Service licensees; adopt the proposed exemption as an option, adopt a 2-watt blanket exemption at least for devices that are typically mounted with a separation distance of 20 cm, and apply any rule changes prospectively; suggests that there should be an automatic exemption at greater than 20 cm but that it is not clear whether our proposed exemption would apply at a separation distance of 20 cm or at 40 cm).

⁷⁷ Private Users Comments at 2-4.

⁷⁸ Private Users Comments at 2.

⁷⁹ FWCC Comments at 2-5. The commenters mention of a potential “anomaly” in an exemption rests on a misunderstanding of what entails an exemption versus a requirement for an evaluation described in more detail in Section IV.A and IV.B, respectively. The formulas in OET Bulletin 65 describe solutions for ERP at given distances rather than distance given ERP. See generally OET Bulletin 65, *supra* note 60.

⁸⁰ UTC Reply at 1, 3-7; see also AT&T Reply at 4-6 (supports the continued exemption of Part 101 microwave facilities, claiming that “microwave antennas are not typically placed where persons could intersect the microwave path ... [and] are typically deployed at substantial heights and produce a narrow beam” presenting a low risk of exposure).

similar height.⁸¹ The Commission's objective is *consistently reliable* compliance with the existing exposure limits, and these sorts of installations warrant an affirmative determination that they are in fact exempt from routine RF exposure evaluation.⁸² Even though such an affirmative determination might require certain licensees to engage in additional effort, the Commission seeks to ensure that the public is adequately protected as new technologies, like 5G, flourish and more transmitters are deployed. We reiterate that the affirmative determinations only involve a simple analysis to determine whether an exemption is applicable.⁸³ Only in cases where the simple RF exemption criteria are not met would an evaluation, and likely a simple one, be needed to establish compliance.⁸⁴

27. We also recognize that many licensees do not control all of the sites at which their antennas are located. However, licensees cannot walk away from their obligations on this basis. Such leasing arrangements are contractual, and licensees can provide for owner attention to this obligation, including responsibility for any losses due to their failure to maintain compliance, as specific provisions of the lease.

28. Verizon contends that our rules may result in a number of network facilities losing their RF-exempt status.⁸⁵ We recognize that the new rules may, in some cases, require applicants and licensees to determine whether an evaluation for compliance with our RF exposure limits is necessary.⁸⁶ Assuming that these facilities comply with the existing RF exposure standards, we do not anticipate any different outcomes.⁸⁷ Moreover, we anticipate that the number of installations that meet the criteria where evaluation is needed will be relatively few. In those cases, as noted earlier licensees already have the necessary information on their transmitters and their installations and would only need to run very simple

⁸¹ Commenters discuss "typical" placements but do not address other placements, which are precisely the situations that may not be exempt and would appropriately require evaluation to ensure compliance. See Private Users Comments at 2-4; FWCC Comments at 2-5; UTC Reply at 1, 3-7; AICC Reply at 1, 10, and 14; AT&T Reply at 4-6.

⁸² See *supra* Section IV.E (where we adopt a two-year transition period for licensees to determine if RF exposure evaluations are required, to perform them where necessary, and to comply with the more specific mitigation requirements we adopt in this order as may be necessary).

⁸³ The factors and calculations used to determine whether a transmitter is exempt can be reused to provide a generic template for ready exemption from evaluation of numerous sites. Even when a full evaluation is conducted, such evaluation may only involve a rough calculation to show that RF levels are less than the exposure limits in our rules.

⁸⁴ FWCC argues that no evaluation should be required where there an installation in which the lowest antenna is 6.3 meters or more above accessible areas, using typical power and antenna directivity, because they demonstrate that compliance can be readily achieved at this distance. In considering antenna directivity—which is not included in our exemption formula—FWCC has performed an evaluation and demonstrated its relative simplicity, and any site with similar characteristics is readily determined to be compliant. Facilities with lower power, greater directivity, or greater height are obviously already effectively evaluated without site-by-site application of the formula. Letter from Cheng-yi Liu, Counsel, Fixed Wireless Communications Coalition, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 13-84, Attach. at 12 (filed Mar. 3, 2016).

⁸⁵ Verizon Comments at 3-4.

⁸⁶ Currently, 47 CFR § 1.1307(b)(1), tbl. 1 identifies services with operations and facilities meeting specific power, location and frequency criteria to be subject to RF exposure evaluation. In addition, 47 CFR § 1.1307(b)(2) requires mobile and portable transmitting devices operating under certain service rules to be evaluated. The new rules will replace these services with the streamlined exemption criteria and remove the specific references in the rules.

⁸⁷ MPE-based exemptions are derived from the MPE exposure limits in Section 1.1310 and Equation 6 of OET Bulletin 65 (Edition 97-01). "The rationale for this derivation is that if these conservative ERP and separation distance exemption criteria are met then there is minimal likelihood for the exposure limits for the general public to be exceeded." See *2013 RF Order and Notice*, 28 FCC Rcd at 3620, App. C.

calculations to ensure compliance with the RF exposure limits.⁸⁸ This presumes, of course, strict adherence to—and where necessary, maintenance of—their installation protocols, and we are confident that licensees will so act. If there are cases where an RF evaluation is necessary and shows a particular RF source is out of compliance, mitigation or modification of the facility is obviously warranted.

29. Although the rules do not require Part 15 devices, except those operating under the provisions of Sections 15.255, 15.257, 15.319, and 15.407,⁸⁹ to provide a routine environmental RF exposure evaluation prior to equipment authorization,⁹⁰ the Commission, nonetheless, requires an evaluation where there is a potential for RF exposure caused by either higher-power emissions or operation in close proximity to users, such as Wi-Fi routers used in residential environments.⁹¹ Commenters like the Alarm Industry Communications Committee (AICC) and UTC argue that low-power/unlicensed devices, used in for example smart meters in homes and businesses, should continue to be exempt as they would be under the old rule.⁹² Our actions in this *Order* will not change these and similarly situated parties' obligations or burdens because the formula underlying the new rules results in similar exemptions as the old rules.⁹³

30. We further clarify that equipment authorized prior to the effective date of this *Order* may continue to be marketed and used under their existing authorizations. Parties deploying such equipment need only ensure that the equipment is installed consistently with the information in the installation manual or user instructions, as provided in the equipment approval, and no further analysis is necessary. In other words, no determination or evaluation for compliance with the RF exposure rules will be required for example low power or unlicensed devices that have been determined compliant with the RF exposure rules under the existing equipment authorization process.⁹⁴

31. As with any other service that would have been otherwise categorically exempt from routine evaluation,⁹⁵ the replacement of the service-based exemptions effectively eliminates the

⁸⁸ To whatever extent such a review may reveal that prior practices resulted in potential noncompliance with our RF exposure rules, such new information cannot be considered a new “burden,” and the obligation to comply has been in place prior to this action.

⁸⁹ 47 CFR §§ 15.255, 15.257, 15.319, 15.407.

⁹⁰ These exemptions are based on calculations and measurement data indicating that such devices under conditions of normal use are unlikely to cause exposures exceeding the guidelines. It should be emphasized, however, that these are not exemptions from compliance, but, rather, only exemptions from routine evaluation. Transmitters or facilities that are otherwise exempt from routine evaluation may be required, on a case-by-case basis, to demonstrate compliance when evidence of potential non-compliance of the transmitter or facility is brought to the Commission's attention, pursuant to 47 CFR § 1.1307(c), (d).

⁹¹ See KDB Publications 447498, 616217, 680106.

⁹² AICC Reply at 1, 10, 14; UTC Reply at 3. Like with mobile devices defined in Section 2.1091(b), smart meters are designed generally to be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the bodies of any nearby persons; as such, such devices qualify for exposure evaluation using MPE limits rather than SAR limits.

⁹³ See *App.* A Section 1.1307(b)(1)(B).

⁹⁴ Where the transmitter is approved as a modular transmitter under Section 15.212, and gets integrated into a host device, the host device manufacturers must ensure compliance with the conditions of the modular equipment authorization grant or must perform a new separate evaluation for the host for RF exposure compliance. For example, a module approved for a mobile device application and used in a portable device application will need a new RF exposure evaluation to the extent that the integration is not conforming with the condition of the module's underlying equipment authorization.

⁹⁵ Radio services wholly exempt from RF exposure routine evaluation are not explicitly included in either Table 1 of Section 1.1307(b)(1) or in Section 1.1307(b)(2).

exemption from routine RF exposure evaluation for Part 18 devices. Many types of Part 18 devices are Industrial, Scientific, and Medical (ISM) equipment often subject to regulatory requirements from other federal agencies⁹⁶ that, due to their controlled occupational operating environments (most often in industrial, medical, or manufacturing facilities), do not present issues or concerns regarding human exposure to RF.⁹⁷ Although the new rules will now require a demonstration of compliance for all Part 18 devices by way of an RF exposure exemption determination or a routine RF exposure evaluation, many of these devices already undergo extensive evaluations associated with RF exposure as part of the regulatory compliance obligations of other federal agencies. The new rules do not require any additional evaluation beyond what they should already undertake. Further, because many Part 18 devices tend to operate in a closely controlled professional environment, any RF concerns can be addressed through mitigation.

32. The American Radio Relay League (ARRL) argues that the routine evaluation exemption for amateur radio stations that operate below a certain power threshold should be maintained.⁹⁸ We are not persuaded that the existing requirement, which limits routine evaluation only to higher-powered amateur station transmitters regardless of distance, is adequate to avoid inadvertent non-compliance with the RF exposure limits. Amateur radio licensees operate a variety of installations of different size, power, and frequency, which can be located in close proximity to people, giving rise to various RF exposure concerns. This further supports the need for consideration of more than just transmitter power alone, as the previous rules had done, as a basis for determining compliance with our RF exposure rules. If the antenna performance characteristics are known, then the process of determining whether the facility is exempt from routine RF exposure evaluation would be as simple as accounting for distance separation to accessible areas in conjunction with the known ERP and operating frequency.⁹⁹ For situations where antenna performance characteristics may not be well understood for a particular amateur radio installation, the most feasible option of demonstrating compliance remains to be evaluated, and various

⁹⁶ For example, magnetic resonance imaging (MRI) systems and medical equipment subject to Food and Drug Administration (FDA) regulations. *See, e.g.*, 21 CFR § 1010.2.

⁹⁷ *See Amendment of Part 18 of the FCC Rules to exempt medical ultrasonic diagnostic and monitoring equipment from technical standards*, Gen Docket No. 85-303, Report and Order, 1 FCC Rcd 553, 553, para. 6 (1986) (stating that “we find that it would be in the public interest to exempt non-consumer medical ultrasonic diagnostic and monitoring equipment from certain administrative and technical standards of Part 18” and that “this exemption will enhance the benefits derived by society from the application of ultrasonics in the field of medicine by reducing the design (including research and development) and marketing costs of monitoring and diagnostic equipment”). Later, in 1994, the Commission added magnetic resonance imaging (MRI) equipment to this list. *See Amendment of Part 18 of the FCC Rules to Remove Unnecessary Regulations Regarding Magnetic Resonance Systems*, ET Docket No. 92-255, Report and Order, 9 FCC Rcd 3389, 3389-90, paras. 6-9 (1994); *see also* <https://www.osha.gov/SLTC/radiofrequencyradiation/index.html>.

⁹⁸ *See* ARRL Comments, ET Docket No. 13-84, at 2-6. Under 47 CFR 97.13(c)(1), amateur radio operators were exempt from evaluation based on power regardless of separation distance. ARRL states that its concern arises from an apparently uneven regulatory burden that disproportionately prejudices amateur radio licensees, and it further asks the Commission to state unequivocally that its exemption criteria “are the preemptive standard, and that States, municipalities, and private land use regulatory authorities such as homeowners’ associations cannot adopt their own, more stringent standards which might preclude or unreasonably restrict the installation of Amateur Radio stations, allegedly due to RF exposure considerations.” *Id.* at 6; *see also* Whedbee Comments at 3-9 (arguing that for amateur operations, technical considerations such as antenna efficiency at lower frequencies and defining separation distance make the proposed exemptions unenforceable); Leggett Comments at 2-5 (claiming that there could be various negative impacts on the amateur community due to the proposals, but that these impacts could be alleviated by authoritative computer models of RF exposure and additional written information provided by the Commission).

⁹⁹ Various simplifying conservative assumptions can be made; for example, if the height of an antenna above unpopulated space is known and is greater than required by the applicable exemption criterion, there is no need to measure lateral distance and calculate the hypotenuse, as that distance will always be greater than the (known) vertical distance.

resources exist to alleviate any burdens that may exist.¹⁰⁰ In addition, for low-frequency, low-efficiency antennas such as those used by many amateur radio licensees, evaluation generally was already required and will continue to be required under the new rules.¹⁰¹

33. We disagree with ARRL's interpretation of the impact of the new exemptions on amateur radio service operations.¹⁰² Contrary to ARRL's desire to interpret our exemptions as precluding any local or municipal RF regulation on amateur radio, our rules will have the same effect on amateur radio – amateur radio facilities were always subject to evaluation when warranted for a particular installation.¹⁰³ Exemptions are a first step in determining RF compliance, and licensees or operators are permitted to choose between determining whether a facility is exempt from routine RF exposure evaluation, or complies with the RF exposure limits based on an evaluation.¹⁰⁴ An exemption determination alleviates the burden of evaluating RF exposure compliance by establishing the unlikelihood of causing exposures that exceed the limits under normal conditions of use, but is not an exemption from compliance, only from routine RF exposure evaluation.

34. We accordingly conclude that as wireless technology rapidly advances, the new requirements of determining and demonstrating RF exposure compliance will best serve all stakeholders. Eliminating service-based exemptions and replacing them with exemptions that are applied uniformly, regardless of the service being offered, simplifies the compliance framework. It ensures that RF sources qualifying for an exemption are in consistently reliable compliance with the applicable exposure limits. The exemptions are tailored to apply only to those uses where the potential of harm to the public is minimal, and the clear and easily applicable standards allow for manufacturers and innovators to readily determine compliance with RF exposure limits. By adopting a service-agnostic approach to exemptions, our rules will no longer unduly burden developers who are making new uses of wireless technology.

1. Exemption Criteria - Single RF Source

35. As proposed in the *2013 RF Further Notice*, a single RF source will be exempt from routine RF exposure evaluation under any one of three circumstances: 1) the RF source transmits at no

¹⁰⁰ When evaluation is required, additional guidance is available in tabulated generic analyses of compliance for broad classes of antennas and installations from the Commission and third parties. See FCC Office of Engineering at Technology, Additional Information for Amateur Radio Stations, OET Bulletin 65, Supplement B, (1997); Ed Hare, *RF Exposure and You*, The Amateur Radio Relay League (1998). This guidance has been available for years and is an acceptable method to determine compliance. These resources were developed by the Commission and private amateur groups, including the ARRL, to aid in determining compliance with the exposure limits. See *id.*

¹⁰¹ That is because exposure is in the reactive near-field and therefore requires further analysis to ensure compliance with our RF exposure rules. See Environmental Protection Agency, *Near-Field Radiation Properties of Simple Linear Antennas with Applications to Radiofrequency Hazards and Broadcasting*, Tell, Richard A., ORP/EAD 78-4 (June 1978).

¹⁰² ARRL Comments at 24 (arguing that the Commission should preempt non-federal RF exposure standards more restrictive than those adopted by the Commission absent a showing that a scientific basis exists for a compelling need for the more stringent regulation or restriction).

¹⁰³ ARRL Comments at 6-7.

¹⁰⁴ Although Section 332(c)(7)(B)(iv) expressly prohibits local governments from regulating “personal wireless service” facilities on the basis of the environmental effects of RF emissions to the extent that such facilities comply with the regulations contained in this chapter concerning the environmental effects of such emissions, these restrictions do not apply to the amateur service. *Modification and Clarification of Policies and Procedures Governing Siting and Maintenance of Amateur Radio Antennas and Support Structures, and Amendment of Section 97.15 of the Commission's Rules Governing the Amateur Radio Service*, Order, 14 FCC Rcd 19413 (1999) (“Section 704 of the Telecom Act, which, among other things, bars state or local regulations that prohibit or have the effect of prohibiting the provision of personal wireless services, does not apply to stations or facilities in the amateur radio service.”).

more than 1 mW average power; 2) the RF source normally operates between 0.5 cm and 40 cm separation from the body, in the frequency range between 300 MHz and 6 GHz, and transmits at no more than the average power threshold result of the formula we adopt based on localized specific absorption rate (SAR) limits; or 3) for all other transmitters, (a) the RF source transmits at no more than the average power threshold result of the set of formulas we adopt based on the maximum permissible exposure (MPE) limits, and (b) the intended operation is normally separated at a distance from any part of the radiating structure of at least $\lambda/2\pi$, where λ is the free-space operating wavelength. These specific exemption criteria are a generally-applicable set of formulas, based on power, distance, and frequency, for all services using fixed, mobile, and portable transmitters. We explain each of these three criteria in turn.

a. 1-mW Blanket Exemption

36. For fixed, mobile, and portable RF sources, we adopt a blanket exemption of 1 mW of time-averaged available (matched conducted) power for RF sources irrespective of distance from the body, as proposed in the *2013 RF Further Notice*.¹⁰⁵ The 1-mW exemption is independent of service type and covers the full range of 100 kHz to 100 GHz, but it may not be used in conjunction with other exemption criteria or in devices with higher-power transmitters operating in the same time-averaging period. Exposure from these higher-power transmitters would invalidate the underlying assumption that exposure from the lower-power transmitter is the only contributor to SAR in the relevant volume of tissue.¹⁰⁶ Also, we clarify that the 1-mW blanket exemption applies at separation distances less than 0.5 cm,¹⁰⁷ including where there is no separation. The record reflects that, at this level of power, emissions from RF sources would fall safely under our existing SAR or MPE exposure limits, which we do not disturb today.¹⁰⁸ Therefore, at these power levels, a blanket exemption, rather than a requirement for RF exposure evaluation or determination of exemption by other means, is appropriate.

37. The medical implant community largely supports the new rule. Medtronic, Inc. (Medtronic), for example, states that it strongly supports the exemption on the ground that it will streamline approval and lower development costs and time-to-market for new medical devices.¹⁰⁹ The Cardiac Rhythm Management Device Committee/Working Group 2 on EMC Protocols of the Association for Advancement of Medical Instrumentation (AAMI-CRMD) similarly supports the underlying

¹⁰⁵ See *2013 RF Order and Notice*, 28 FCC Rcd at 3538, para. 121.

¹⁰⁶ See *id.*

¹⁰⁷ See IT'IS Foundation Comments at 3 (seeking clarification that the 1 mW exemption applies at separation distances less than 0.5 cm, even while the SAR-based exemptions are not valid at less than 0.5 cm); *2013 RF Order and Notice*, 28 FCC Rcd at 3555, para. 168. Modern transmitting implants are generally too small to allow 0.5 cm or more of separation distance and the impact on SAR of dielectric material that could be used to increase separation between antennas and tissue is unknown. See Appx. A, 47 CFR § 1.1307(b)(1)(i)(A).

¹⁰⁸ See Motorola Comments at 4 (“As the Commission notes, under current rules, any transmitter with power of 1.6 mW or lower will be inherently compliant with the Commission’s specific absorption rate (“SAR”) limit, so conducting routine evaluations on any such devices is unnecessary.”); Medtronic Comments at 3 (“The Commission’s localized SAR limit of 1.6 W/kg averaged over 1 gram cannot be exceeded if the available power from a transmitter is less than 1.6 mW, regardless of frequency and distance over the applicable SAR frequency range of 100 kHz to 6 GHz. Put differently, single transmitters operating at 1 mW cannot exceed the Commission’s exposure limits based on conservation of energy principles. Thus, a blanket exemption from routine environmental evaluation for these transmitters is appropriate.”); Wi-Fi Alliance Comments at 3 (“the proposed 1 mW exclusion and the scale proposed by the Commission are overly conservative and are inconsistent with current devices. Adoption of the IEC standard will reduce unnecessary and costly compliance testing.”); Wi-Fi Alliance Reply at 11 (“Many parties agreed with Wi-Fi Alliance that the current 1 mW exclusion is unnecessarily conservative and that the Commission should adopt the IEC 62479 standard instead.”).

¹⁰⁹ See Medtronic Comments at 2-3.

principles of the 1 mW exemption, commenting that such a measure would simplify regulatory approval for all medical device manufacturers.¹¹⁰

38. Medtronic and the AAMI-CRMD recommend a more relaxed threshold of 20 mW to align with more recent RF exposure guidelines and to support future devices, which are expected to have improved batteries and may operate with greater average power.¹¹¹ They contend that while most of the existing (transmitting) implants would fall below the 1-mW threshold because of existing battery constraints, greater power will be needed in the future to accommodate the increased range, data rates, and reliability anticipated in the next generations of devices.¹¹² We decline to increase the 1-mW threshold. The blanket 1-mW exemption is based on the existing Commission SAR limit below 6 GHz (and on the existing Commission MPE limit above 6 GHz).¹¹³ They do not compellingly make the case to change the Commission's existing underlying SAR limit to another upon which 20 mW would be based, and we decline to do so at this time. Moreover, our new rules do not prohibit the authorization of medical implants operating with power exceeding 1-mW; only that such devices would require routine evaluation for certification, which until now had been the case for all implant devices that contain wireless communications capabilities.¹¹⁴

39. Motorola suggests that the general public SAR limits should not apply when requesting an exemption for exposure from implanted medical devices.¹¹⁵ Instead, Motorola suggests applying IEC 60601-2-33 for implanted medical devices,¹¹⁶ which provides higher SAR limits, (e.g., normal partial body SAR ranging between 2 W/kg and 10 W/kg, as averaged over 10 grams, depending on exposed mass) on the grounds that these devices are implanted under medical supervision.¹¹⁷ We will not consider such a change, as the issue is outside the scope of this rulemaking. Our rules will continue to provide that all devices using RF energy for communications (or, e.g., power transfer) in a medical context are subject to Commission RF exposure limits for purposes of requesting an exemption.

40. Motorola urges the Commission to adopt the International Electrotechnical Commission (IEC) 62479 (2010) criteria,¹¹⁸ which provides a 1.6-mW exemption from 100 kHz to 6 GHz as a blanket exemption. We disagree. Adopting the 1.6 mW standard is not appropriate because it does not include a

¹¹⁰ See AAMI-CRMD Comments at 5.

¹¹¹ See Medtronic Comments at 2-3, 5; AAMI-CRMD Comments at 5.

¹¹² AAMI-CRMD suggests that the Commission increase the exemption level consistent with the SAR limits from IEEE standards and ICNIRP guidelines. IEEE-ICES urges the Commission to adopt the local SAR limit of 2 W/kg averaged over 10 g of tissue that would result in a blanket exemption power of 20 mW. (IEEE-ICES Comments at 9.) As discussed in our resolution of this issue, these arguments are based on SAR limits that are different from those in our extant rules and thus are outside the scope of this rulemaking. See *supra* para. 37.

¹¹³ See 47 CFR § 1.1310.

¹¹⁴ See 47 CFR § 1.1307(b)(2).

¹¹⁵ See Motorola Comments at 6.

¹¹⁶ International Electrotechnical Commission, International Standard IEC 60601-2-33, Edition 3.0, "Medical electrical equipment - Part 2-33: Particular requirements for the basic safety and essential performance of magnetic resonance equipment for medical diagnosis" (2010).

¹¹⁷ See *id* at 4-7.

¹¹⁸ International Electrotechnical Commission, International Standard IEC 62479, Edition 1.0, "Assessment of the compliance of low-power electronic and electrical equipment with the basic restrictions related to human exposure to electromagnetic fields (10 MHz to 300 GHz)" (2010).

margin for power measurement uncertainty.¹¹⁹ As a result, a 1.6 mW standard could reasonably result in RF exposure in excess of our SAR limit.

41. CDE expresses caution with respect to use of the 1-mW threshold for non-medical devices because of possible device software reconfiguration to operate at higher power.¹²⁰ CDE is concerned of possible changes to the device after its grant of authorization. However, our rules require that the responsible parties certify that the equipment marketed under the grant of certification conforms with the rated operational characteristics of the unit for which measurements were filed with the application of certification.¹²¹ Any radio in which the software is designed to be modified by a third-party other than the manufacturer must comply with the requirements of a software defined radio specified in Section 2.944 of our rules.¹²² The applications for certification will have to show clearly the maximum possible power of operation and, if there is software to control it, also describe the procedures to ensure that it cannot be modified.¹²³ If the device is capable of operating at power levels greater than permitted by the exemption threshold, it will not be authorized. If there is unauthorized modification, the device will be operating outside its grant of authorization and subject to enforcement action.¹²⁴

b. SAR-Based Exemption

42. The SAR-based thresholds are derived based on the frequency, power, and separation distance of the RF source.¹²⁵ The formula in Table 1 defines the thresholds in general for either available maximum time-averaged power or maximum time-averaged ERP, whichever is greater.¹²⁶ If the ERP of a device is not easily determined, such as for a portable device with a small form factor, the applicant may use the available maximum time-averaged power¹²⁷ exclusively if the device antenna¹²⁸ or radiating structure does not exceed an electrical length of $\lambda/4$.¹²⁹ As for devices with antennas of length greater

¹¹⁹ Analogously, in the FCC Laboratory's guidance on SAR compliance, test reduction procedures incorporate an additional margin (typically 1.2 W/kg or less compared to 1.6 W/kg) for similar reasons.

¹²⁰ See CDE Comments at 2.

¹²¹ 47 CFR § 2.931.

¹²² 47 CFR § 2.944.

¹²³ 47 CFR § 2.1033.

¹²⁴ 47 CFR § 2.803.

¹²⁵ See *2013 RF Order and Notice*, 28 FCC Rcd at 3624, Appx. D. The separation distance is the smallest distance from any part of the antenna or radiating structure for all persons, including those occupationally exposed, during operation at the applicable ERP. In the case of mobile or portable devices, the separation distance is from the outer housing of the device where it is closest to the antenna.

¹²⁶ Certain service rules use equivalent isotropically-radiated power (EIRP) rather than ERP, which is defined in our new rules (47 CFR § 1.1307(b)) for exemption purposes as the product of the maximum time-averaged power delivered to the antenna and its maximum gain in any direction relative to a half-wave dipole. EIRP equals 1.64 times the ERP. Similar to the definition of ERP, the definition of EIRP is the product of the maximum time-averaged power supplied to the antenna and its maximum gain in any direction relative to an isotropic antenna. Since our exemption criteria are defined in terms of ERP, we do not include this definition for EIRP in our rules, rather the exemptions for EIRP for service rules that use it may be derived by multiplying instances of ERP in our exemption formulas by this 1.64 factor.

¹²⁷ This available maximum time-averaged power would be the maximum power delivered into a matched antenna, considering line loss or any other loss that diminishes power delivered to an antenna.

¹²⁸ A coherent phased array of antenna elements is to be treated as a single antenna or RF source because coherent fields sum by field strength and not by power, so the summation given later should not be used in this case. Separation distance of a coherent phased array of antenna elements is from the nearest element.

¹²⁹ See Roger F. Harrington, *Effect of Antenna Size on Gain, Bandwidth, and Efficiency*, 64D, No. 1, Journal of Research of the National Bureau of Standards, Radio Propagation 1-12 (January-February 1960).

than $\lambda/4$ where the gain is not well defined but always less than that of a half-wave dipole (length $\lambda/2$), the available maximum time-averaged power generated by the device may be used in place of the maximum time-averaged ERP, where that value is not known. This would apply, for instance, to “leaky” coaxial distribution systems, RF heating equipment, and other (typically unintentionally) radiating or Industrial, Scientific, and Medical (ISM) devices. The SAR-based exemption threshold P_{th} is defined in terms of maximum time-averaged power and in accordance with the source-based time-averaging requirements described in section 2.1093(d)(5). Time-averaged power measurements are necessary to determine if the maximum output of a transmitting antenna (ERP) or transmitter matched conducted power is above the proposed threshold for exemption or routine SAR evaluation.¹³⁰

¹³⁰ The power measurement and SAR test procedures required to determine the number and types of SAR tests necessary to demonstrate device compliance will be available in procedures established by the OET Laboratory and published in the KDB. KDB publications have referenced 3GPP and 3GPP2 power measurement requirements; however, when such test configurations and procedures are not appropriate for SAR or RF exposure evaluation purposes, the OET Laboratory will provide power measurement guidance. Moreover, some power measurement procedures may be specific to the particular wireless technology under consideration (*e.g.*, Wi-Fi).

Table 1. Time-Averaged Power Thresholds (mW) for Exemption of Single Portable, Mobile, and Fixed RF Sources, 0.3-6 GHz

A source is exempt if each of the maximum time-averaged available (matched conducted) power and effective radiated power (ERP) is no more than:

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20\text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20\text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$$

where:

$$x = -\log_{10} \left(\frac{60}{ERP_{20\text{ cm}} \sqrt{f}} \right) \text{ and}$$
$$ERP_{20\text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

Use the formula at distances (d) from 0.5 cm to 20 cm and frequencies from 0.3 GHz through 6 GHz; the constant values obtained by the formula at exactly 20 cm apply between 20 cm and 40 cm. Units for *d* are cm and units for *f* are GHz. Example values shown in the following table are for illustration only.

Example Power Thresholds (mW)													
Distance (cm)													
	0.5	1	1.5	2	2.5	5	7	10	12.5	15	17.5	20	40
0.3	39	65	88	110	130	220	280	360	430	490	550	610	610
0.45	22	44	67	89	110	230	320	460	570	690	800	920	920
0.835	9.2	25	44	66	90	240	390	640	880	1100	1400	1700	1700
0.9	8.3	23	42	63	88	240	400	670	920	1200	1500	1800	1800
1.45	4.3	15	30	50	74	250	460	870	1300	1800	2300	3000	3000
1.8	3.5	13	26	45	67	240	450	860	1300	1800	2400	3060	3060
1.9	3.4	12	26	44	66	240	440	850	1300	1800	2400	3060	3060
2.45	2.7	10	22	38	59	220	420	820	1300	1800	2400	3060	3060
3	2.3	9.0	20	35	53	210	400	790	1200	1700	2400	3060	3060
5.2	1.5	6.3	15	26	42	170	350	730	1200	1700	2300	3060	3060
5.8	1.4	5.9	14	25	40	170	340	720	1100	1700	2300	3060	3060

43. This formula provides a straightforward and easy-to-use method for regulated parties to use as part of the process in evaluating their compliance with the existing RF exposure limits. The algorithm accounts for the major contributing variables in RF exposure (frequency, distance, and power), ensuring that exposure levels stay safely below our established limits. We have set the parameters of this formula to cover a wide range of use cases, while not unnecessarily complicating the calculations, allowing parties to readily determine if a device qualifies for the exemption.

44. A number of parties support the Commission's uniform formula for SAR exemption.¹³¹ For example, the IT'IS Foundation supported the principle of the SAR-based exemption, agreeing that the

¹³¹ See IT'IS Foundation Comments at 3 (supports the exemptions as proposed and finds them consistent with its research and easy to apply). As indicated in the 2013 RF Order and Notice, this approach to exemptions came about from commenters in response to our 2003 Notice offering broad support for the idea of simplifying our criteria and making them consistent across all services, and for the Commission to consider a "sliding scale" or a more detailed scheme for defining exemptions based on simple calculation methods. See 2013 RF Order and Notice, 28 FCC Rcd at 3545, para. 140.

exemption should be based on physical characteristics rather than service type and that such exemptions are consistent with protecting the public, while reducing the costs of regulation.¹³²

45. Other commenters suggested alternatives to our proposed approach, but we decline to adopt them. The Wi-Fi Alliance contends that the proposed SAR-based exemptions are too conservative and inconsistent with the operation of current devices.¹³³ Similarly, IEEE-ICES urges the Commission to adopt a higher SAR exposure limit of 2 W/kg averaged over 10 g, a limit used elsewhere in the world and resulting in RF exposure levels that are significantly higher than those under our rules.¹³⁴ Instead, these parties support the use of technical standard IEC 62479 (2010), which provides alternative recommendations for exemption of low-power devices based on SAR.¹³⁵

46. We are not persuaded that the IEC standard should be adopted at this time. Even though the IEC's standard—like our proposal—uses dipoles and flat phantoms¹³⁶ as a starting point for modeling and the same frequency range (300 MHz-6 GHz), it departs significantly with respect to the applicable range of separation distances and use of bandwidth, with increased complexity in the resulting formulas. In an effort to maintain simplicity, we have limited the exemptions to those based solely on the relationship of power (both available or matched power and ERP), distance, and frequency without other inputs that would effectively render an exemption determination as complex as an evaluation (such as antenna pattern or bandwidth). Additionally, while our proposal uses a separation distance of 0.5- cm to 40 cm, the IEC standard uses a smaller distance, 0.5 cm to 2.5 cm. This is problematic, because numerous devices that might be subject to the SAR-based exemption operate with a separation distance of more than 2.5 cm.¹³⁷ Further, the rules we adopt use a reduced target SAR value in derivation in order to cover the range of several device parameters including bandwidth, while IEC uses transmitter bandwidth as a parameter to allow higher powers for wider bandwidth devices,¹³⁸ reducing the simplicity of this SAR exemption.

47. As the IT'IS Foundation and Whedbee point out, there are several other parameters that could be considered besides bandwidth, but we conclude that additional complexity in the exemption formula would result in regulations that are of little or no practical utility as a simple exemption protocol; additional factors can be taken into account as needed or appropriate in a more thorough evaluation to demonstrate compliance.¹³⁹ Finally, the IEC model does not directly incorporate antenna directivity and states that it may not apply to devices with highly directive antennas;¹⁴⁰ however, the new rules address

¹³² See IT'IS Foundation Comments at 2-3.

¹³³ Wi-Fi Alliance Comments at 3.

¹³⁴ IEEE-ICES Comments at 9 (referencing Annex A of IEC 62479 and recognizing that the blanket exemption (up to 6 GHz) has been derived from the existing SAR limit).

¹³⁵ See Wi-Fi Alliance Comments at 3; IEEE-ICES Comments at 9; Motorola Comments at 5-6; MWF Comments at 4,13-14 (encourages the use of IEC 62479, but also supports the use of time-averaged power).

¹³⁶ A flat phantom is a planar model of absorbing tissue.

¹³⁷ MWF suggests we include an explanation of why our SAR-based exemptions are constant at separation distances between 20 cm and 40 cm. See MWF Comments at 14. We clarify that these constant values avoid discontinuities in the threshold when transitioning between SAR-based and MPE-based exemption criteria at 40 cm, considering the importance of reflections.

¹³⁸ SAR is simpler and results in no more exposure (and often less) than the IEC formulation. See *2013 RF Order and Notice*, 28 FCC Rcd at 3624, Appx. D.

¹³⁹ IT'IS Foundation Comments at 3; Whedbee Comments at 9 (Whedbee objects to the purported complexity of our proposed exemption criteria but appears to overlook that not all potential exemption input parameters are necessary to ensure compliance in most situations and that further simplicity could make the exemptions more conservative than necessary).

¹⁴⁰ IEC 62479, Edition 1.0, at 14, Annex B.

this by limiting ERP (in addition to available power) which accommodates the greater exposure that may result from antenna directivity. In addition, with respect to IT'IS Foundation's suggestion that we extend the SAR-based exemption formula from 0.5 cm to 0 cm to account for wearable technologies, we decline to do so, because there is no modeling data that validates such an extension.¹⁴¹

c. MPE-Based Exemption

48. We also adopt our proposed general frequency and separation-distance dependent MPE-based effective radiated power (ERP) thresholds in Table 2 to support an exemption from further evaluation from 300 kHz through 100 GHz in frequency, as proposed in the *2013 RF Order and Notice*.¹⁴² The table we adopt applies to any RF source (i.e. single fixed, mobile, and portable transmitters) and specifies power and distance criteria for each of the five frequency ranges used for the MPE limits. These criteria, shown in Table 2 below, apply at separation distances from any part of the radiating structure of at least $\lambda/2\pi$.¹⁴³ The thresholds in Table 2 are based on the general population MPE limits with a single perfect reflection, outside of the reactive near-field, and in the main beam of the radiator. When the maximum time-averaged effective radiated power is no more than the value calculated from the formulas, the source is exempt from further evaluation.¹⁴⁴ The record reflects that, at the levels of power, distance, and frequency reflected by this formula, emissions from RF sources would fall safely under our existing MPE exposure limits, which we do not disturb today.¹⁴⁵ Therefore, an exemption at the threshold ERP levels reflected in Table 2, rather than case-by-case evaluation, is appropriate.

¹⁴¹ See IT'IS Foundation Comments at 3.

¹⁴² See *2013 RF Order and Notice*, 28 FCC Rcd at 3540-44, paras. 128-138.

¹⁴³ In Table 2, if $R < \lambda/2\pi$, evaluation is required. Since $\lambda/2\pi$ is > 20 cm at frequencies below 239 MHz, these exemption criteria do not apply to portable devices that are operated both at less than 20 cm from the body and at frequencies below 239 MHz. In general, less restrictive SAR-based exemption criteria may be used in accordance with the formulas specified in Table 2, but these SAR-based exemptions are not valid below 300 MHz. Thus, there are no exemption criteria below 239 MHz for portable devices (or for any antenna at less than 20 cm) other than the 1 mW blanket exemption. The $\lambda/2\pi$ distance in meters may be conveniently calculated using the formula: $47.7/f$ where f is the operating frequency in megahertz.

¹⁴⁴ See *2013 RF Order and Notice*, 28 FCC Rcd at 3620, Appx. C; see also OET Bulletin 65, Equation 6. In some cases, where ERP is not well defined the available maximum time-averaged power may be used as Threshold ERP. See *id.* at 3512, para. b. Also, rather than specify inequality formulas in Table 2, we instead, specify thresholds where an equal or lesser ERP to the Threshold ERP specified in Table 2 for the transmitter operating frequency would be considered exempt from evaluation.

¹⁴⁵ See WIA Comments at 4; Motorola Comments at 4; Wi-Fi Alliance Comments at 2; Verizon Reply at 2-4.

Table 2. Single RF Sources Subject to Routine Environmental Evaluation under MPE-Based Exemptions, $R \geq \lambda/2\pi$

Transmitter Frequency	Threshold ERP
0.3 – 1.34	1,920 R ²
1.34 – 30	3,450 R ² /f ²
30 – 300	3.83 R ²
300 – 1,500	0.0128 R ² f
1,500 – 100,000	19.2 R ²
<i>Note:</i> Transmitter Frequency is in MHz, Threshold ERP is in watts, R is in meters, f is in MHz.	

49. Single RF sources are exempt if, using Table 2 above, for the frequency (f in MHz) and separation distance (R in meters) at which the source operates, the ERP (in watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 2 to apply, the separation distance in meters, R,¹⁴⁶ must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength. If the ERP of a single RF source is not easily obtained, then the available maximum (source-based) time-averaged power may be used in lieu of ERP if the device antenna(s) or radiating structure(s) do not exceed the electrical length of $\lambda/4$. If the ERP of the single RF source and transmitting antenna(s) (including coherent array) exceeds the ERP threshold, then the RF source is not exempt and the applicant must prepare an evaluation.¹⁴⁷

50. As with our SAR-based exemption, we have crafted our MPE-based exemption to ensure that any source falling within the exemption will not expose members of the public to RF levels beyond our established standards. The formula for the MPE-based exemption is designed to apply to a wide range of applications, while still ensuring a relatively simple calculation.

51. A number of commenters expressed support for our proposed approach. WIA commented in favor of replacing service-based exemptions with broadly applicable standards, noting that service-based exemptions were subject to change and thus difficult to keep up to date.¹⁴⁸ Similarly, Motorola generally supported the notion of developing an MPE-based exemption based on power, distance, and frequency, noting that because RF exposure is a function of these factors “it is sensible to identify minimum thresholds below which evaluation is unnecessary.”¹⁴⁹

52. Even though WIA supports this approach, it contends that the exemption criteria are too restrictive and suggests adjusting the formulas to more readily exempt transmitters mounted on dedicated, access-controlled wireless support structures in the frequency range of 300 MHz to 3 GHz.¹⁵⁰ Similarly,

¹⁴⁶ The definition for separation distance in this calculation is identical to that concerning SAR-based thresholds. See *supra* para. 42.

¹⁴⁷ At sites with multiple fixed transmitters, or with multiple mobile or portable transmitters within the same device, the formulas would be applied in conjunction with the summations discussed in the section on Exemption Criteria - Multiple RF Sources, Section IV.A.2 below.

¹⁴⁸ See WIA Comments at 4.

¹⁴⁹ See Motorola Comments at 5.

¹⁵⁰ WIA Comments at 4-5; WIA Reply at 2-3; Verizon Comments at 3-4 (contends that the Commission’s proposal mixes spatially-averaged and spatial-peak power density which results in an over-estimation of far-field power

(continued....)

Verizon proposes a modified exemption formula—one that would apply between 400 MHz and 3 GHz,¹⁵¹ concerned that the proposed exemption criteria would result in a number of network facilities losing their exempt status.¹⁵² WIA and Verizon argue that certain transmitters would present a *de minimis* risk of non-compliance with our rules.¹⁵³

53. Given recent developments in wireless infrastructure deployment, we conclude it is more appropriate to adopt refraining from such a broad alternative exemption formula for small cell or DAS transmitters. Rather, the exemption formulas we adopt in this *Order* will apply to small cell or DAS transmitters, as it does to other transmitters as well.¹⁵⁴ Further, for similarly-located small cell deployments that share technical characteristics (i.e. a small cell deployment with the same equipment placed at the same height), licensees can use the same exemption for all such small cell deployments. Although small cell and DAS transmitters were likely to be exempt under our previous rules, those exemptions were premised on the assumption that they were not being placed in or near publicly accessible areas.¹⁵⁵ The fact that small cell or DAS transmitters are “building-mounted” today does not preclude persons from having access to the front of antennas that could previously be presumed to always be distant from people, particularly when mounted low to the ground or in other accessible locations, and the actual distance from potential human presence should be taken into consideration.¹⁵⁶

54. Further, we decline to adopt Verizon’s proposal to relax the standard for “transmitters located on structures where access can more readily be controlled.”¹⁵⁷ While a supporting structure, such

(Continued from previous page)

density and a threshold power density that is too low, which would result in more transmitters not being considered exempt).

¹⁵¹ Verizon Comments at 3-4.

¹⁵² Verizon Comments at 3-4; Verizon claims that while the Commission’s use of 100 percent reflection in its derivation is appropriate to predict peak power density, it is inappropriate for predicting spatially-averaged power density, based on ground reflection and spatial averaging along a vertical line. Verizon is the only commenter to attempt to substantiate its argument - in its Technical Appx. A, it provides a technical justification of its conclusion that between 400 MHz and 3 GHz access-limited transmitters should be exempt if their ERP in watts is less than $76 R^2$ with R the separation distance in meters. See Verizon Comments at 4, Appendix A Verizon uses the same formula as the Commission, including 100 percent reflection, but incorporates the IEEE Std C95.1-2005 spatial peak power density value of 40 W/m² between 400 MHz and 3 GHz to calculate an ERP threshold of $76 R^2$. *Id.*; see also *AT&T Comments* (AT&T provides an example of a base station transmitter that would be exempt under the current rules but would no longer be exempt under the proposed rules, agreeing with WIA and Verizon and supporting their proposal for a modified exemption formula where access is controlled); CTIA Reply at 33-35 (arguing that small cell sites present little or no risk).

¹⁵³ See WIA Comments at 4; Verizon Reply at 2-4.

¹⁵⁴ WIA and Verizon’s proposed alternative formula that would take into account additional relevant characteristics of the antenna and the site will result into a formula that more closely resembles the evaluation rather than the exemption process.

¹⁵⁵ See *1996 Order*, 11 FCC Rcd at 15157, para. 89 (discussing that some transmitting facilities, regardless of service, may pose exposure concerns above MPE limits because high operating power, location or relative accessibility and use of such variables that apply generally to all transmitting facilities); *Id.* at 15158, para. 91 (discussing high operating power transmitters may need to be evaluated if certain conditions apply, such as when workers or the public could have access to the transmitter site, supporting need for routine evaluation)

¹⁵⁶ See *Second Memorandum Opinion and Order and Notice of Proposed Rulemaking*, 12 FCC Rcd at 13534, para. 104. The Commission replaced the term “rooftop” with the term “building-mounted” in its rules “to make it clear that our [exemptions from RF exposure routine evaluation requirements] apply to transmitters mounted on the sides of buildings as well as those mounted on building roofs . . . [to] remove possible confusion in the existing rules and . . . avoid potential situations where persons could be exposed to RF emissions in excess of our guidelines.” *Id.*

¹⁵⁷ See Verizon Comments at 4.

as a utility pole, may not be publicly accessible, adjacent spaces, like sidewalks, yards, or rights-of-way, may be accessible, rendering the transmitter appropriate for evaluation.¹⁵⁸ Although small cells and DAS transmitters may not be exempt under our new rules, the necessary determination of exemption or evaluation can be done simply and inexpensively. In the typical case of a structure as suggested by Verizon, the appropriate placement of the antenna can provide the basis for an exemption and can be readily replicated for other structures.¹⁵⁹ For a typical building- or roof-mounted antenna or a directional antenna, a routine evaluation can often take into account relevant characteristics of the antenna and the site to demonstrate compliance through a simple calculation. Our ongoing policy to consider other methods and procedures if based on sound engineering practice does not preclude other more complex procedures which sufficiently demonstrate compliance, such as performance of an RF exposure evaluation using the methods similar to those WIA and Verizon have proposed. We acknowledge that in some cases the simplicity of the exemption provisions may require an evaluation that would not be required if the formula was more complex. We conclude, however, that we have struck the right balance between simplicity, accuracy, and ensuring safety, as well as between requiring more complex analysis in all cases and requiring it in only a small percentage of cases. Further, we find that Verizon's alternative formula is based on inappropriate assumptions,¹⁶⁰ and cannot ensure compliance with the Commission's RF exposure limits.

¹⁵⁸ Verizon Comments at 3-7; WIA Reply at 2, 3. While Verizon's analysis purports to demonstrate that the maximum spatially-averaged exposure at ground level would be 17.1 percent of the Commission general population/uncontrolled limit and a similar analysis at the height of the antenna gives a maximum exposure of 57.1 percent of the limit, this analysis was performed with the minimum transmitter power and minimum antenna gain for small cells—a best case, rather than a worst case (or even typical case). See Verizon Comments at Appendix B. It is not apparent that realistically higher power and/or gain would not cause exposure over the limit. As Verizon itself shows, its proposed exemption formula gives a potential ERP threshold for an occupant of the example phone booth of 44.13 watts which is 4.413 times greater than the 10 watt ERP used in its calculation; resulting in a calculation of exposure that is 252 percent of the general population exposure limit at the height of the antenna and up to 75.5 percent spatially averaged at ground level, suggesting a significant risk of excessive exposure in the space occupied by a body (*i.e.*, appreciably above ground level). See *id.* (The ERP ratio of 4.413 (from 44.13 W/10 W) times 17.1% and 57.1% gives 75.5% and 252%, respectively.).

¹⁵⁹ For example, if calculation determines that for a particular transmitter power and antenna type, the closest location at which the exposure limit is exceeded is X, installation elements that assure the antenna distance exceeds X can be repeatedly used without further assessment of each site.

¹⁶⁰ Verizon's alternative formula assumes inappropriately that reflections cause only peak field exposure and it uses IEEE (2005) peak field limits while ignoring both the IEEE and the Commission's whole-body exposure limits. The Commission's rules do not set a relaxed limit on spatial peak power density. Even a simple free-space (without reflection) calculation shows that, accepting Verizon's proposed change, the formula would allow a uniform power density over the body (independent of distance R) to considerably exceed the Commission's general population exposure limit; for example, at 400 MHz, it would exceed the limit almost 4 times (a factor of 3.72). (See OET Bulletin 65 eq. (5), $S = 1.64 \text{ ERP}/4\pi R^2$, inserting Verizon's formula of $\text{ERP} = 76 R^2$ gives a constant power density of $S = 9.92 \text{ W/m}^2$ and the Commission general population/uncontrolled limit at 400 MHz is $S = 2.67 \text{ W/m}^2$ ($9.92/2.67 = 3.72$) and rises to 10 W/m^2 at 1500 MHz.) While this overage would be smaller at higher frequencies, it does not consider reflections, which would increase exposure beyond that calculated for free-space. As for spatial field variations, Verizon's argument that reflections only result in partial body exposures is not valid. For example, in the case of an individual standing between a vertical reflector (*e.g.*, a wall with metallic elements or a large metal appliance or pole) and a transmitting antenna, the electric field at one-quarter wavelength and continuing at one-half wavelength intervals from the reflector could be doubled (with 4 times the equivalent power density) and uniform as measured over a vertical line – a standard method for spatial averaging. Verizon fails to account for such vertical reflectors and resulting spatially-averaged field enhancements, which are particularly relevant at urban wireless facilities as powers increase and antennas continue to be installed on and adjacent to buildings.

2. Exemption Criteria - Multiple RF Sources

55. In this section, we address how to treat multiple RF sources in determining whether they are exempt from routine RF exposure evaluation. We adopt a modified version of our 2013 proposals describing the appropriate summation formulas and the circumstances in which they apply.¹⁶¹

a. 1-mW Exemption

56. For multiple RF sources inside a single device,¹⁶² each of which is capable of no more than 1 mW, we adopt a minimum 2-cm separation distance between antennas that operate in the same time-averaging period, as proposed in the *2013 RF Further Notice*.¹⁶³ In other words, if there are two or more RF sources inside a single device operating at the same time and the nearest parts of the antenna structures are separated by less than two centimeters, the 1-mW exemption will not apply. However, if the sum of multiple sources that can operate at the same time is less than 1 mW during the time-averaging period, they may be treated as a single source (separation is not required), and exempted accordingly. As with the exemption for a single RF source, this exemption cannot be used in conjunction with other exemption criteria, and medical implant devices may use only this 1-mW exemption. The record reflects that, based on these separation distances, emissions from multiple RF sources at no more than 1 mW power each would fall safely under our existing RF exposure limits, which we do not disturb today.¹⁶⁴ Therefore, we conclude that a blanket exemption, rather than case-by-case evaluation, is appropriate.

b. Use of Summation Formulas

57. In situations where RF exposure is generated from multiple sources at the same time, all such sources are considered in the aggregate to determine compliance with the exposure limits. The SAR- and MPE-based exemptions may be used along with known existing exposure levels to exempt multiple RF sources.¹⁶⁵ This is accomplished by normalizing each source power level to each matching exemption threshold power and determining whether the total of all the normalized powers¹⁶⁶ is no more than 1, meaning the summation of the percentages of the threshold from each RF source involved is no more than 100 percent of the threshold for the given exposure conditions. In addition, if pre-existing exposure levels are known, they may also be normalized to the exposure limits to determine the remaining margin for exemption of additional sources to demonstrate compliance with the limit. These concepts are applied to the antennas of multiple transmitters in a single device and to multiple fixed transmitters, as explained below.

(i) Multiple RF Sources with Fixed Physical Relationship

58. Typical devices today contain several transmitters and radiating antennas, some of which can operate at the same time. To address these various exposure conditions, we adopt the single summation formula below for all RF sources, regardless of whether portable, mobile, or fixed, which has

¹⁶¹ *2013 RF Order and Notice*, 28 FCC Rcd at 3544-47, paras. 139-44, 3550-54, paras. 154-65.

¹⁶² See 47 CFR § 2.1 Terms and definitions. *End Product*. A completed electronic device that has received all requisite FCC approvals and is suitable for marketing.

¹⁶³ *2013 RF Order and Notice*, 28 FCC Rcd at 3538, para. 121, 3555, para. 168.

¹⁶⁴ See Motorola Comments at 4; Medtronic Comments at 3; Wi-Fi Alliance Comments at 3; Wi-Fi Alliance Reply at 11.

¹⁶⁵ See *infra* Appx. A, Amended Rule 47 CFR § 1.1307(b)(1)(ii).

¹⁶⁶ Normalization here means dividing an RF source power level by the corresponding exemption threshold power; if the result is less than 1 for a single source, then that source is exempt. For example, if the source power is 30 W and the exemption threshold is 40 W, the normalized power would be 0.75, which is less than 1, so the single source would be exempt. If a second source is at 0.14 of its exemption threshold, the two together will sum to 0.89 of the threshold, which would be an exempt 2-transmitter installation. If an existing exposure is known to be (by calculation or measurement) 0.10 of the limit, the total is still 0.99 and the facility is exempt.

been modified since our 2013 proposals which provided for different formulas for portable, mobile and fixed transmitters, to combine these disparate efforts into a single formula for more general applicability.¹⁶⁷ For sites or devices with multiple transmitters, the summation formula shown below will determine whether multiple transmitters using the single transmitter formulas are collectively exempt from evaluation. This formula includes three summation terms, the first two of which are summations for the exemptions, the third is to account for exposure from existing evaluations, which we will describe in more detail below.

59. To quantitatively exempt any new or modified transmitter in a device or at a multiple transmitter location,¹⁶⁸ one must add the contribution of each source expressed as a percentage of the allowable maximum and those percentages must add up to no more than 100 percent of the allowance in the applicable formulas in Table 1 or Table 2 above, as expressed by this formula:

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$$

Where

- a = number of fixed, mobile, or portable RF sources claiming exemption using the Table 1 formula for P_{th} , including existing exempt transmitters and those being added.
- b = number of fixed, mobile, or portable RF sources claiming exemption using the applicable Table 2 formula for Threshold ERP, including existing exempt transmitters and those being added.
- c = number of existing fixed, mobile, or portable RF sources with known evaluation for the specified minimum distance.
- P_i = the available maximum time-averaged power or the ERP, whichever is greater, for fixed, mobile, or portable RF source i at a distance between 0.5 cm and 40 cm (inclusive).
- $P_{th,i}$ = the exemption threshold power (P_{th}) according to the Table 1 formula for fixed, mobile, or portable RF source i .
- ERP_j = the available maximum time-averaged power or the ERP, whichever is greater, of fixed, mobile, or portable RF source j .
- $ERP_{th,j}$ = exemption threshold ERP for fixed, mobile, or portable RF source j , at a distance of at least $\lambda/2\pi$, according to the applicable Table 2 formula at the location in question.
- $Evaluated_k$ = the maximum reported SAR or MPE of fixed, mobile, or portable RF source k either in the device or at the transmitter site from an existing evaluation.
- $Exposure Limit_k$ = either the general population/uncontrolled maximum permissible exposure (MPE) or specific absorption rate (SAR) limit for each fixed, mobile, or portable sources, as applicable.¹⁶⁹

¹⁶⁷ In 2013 we proposed different formulas for summing multiple fixed transmitters (2013 RF Order and Notice, 28 FCC Rcd at 3544-46, paras. 139-141), multiple portable transmitters (2013 RF Order and Notice, 28 FCC Rcd at 3550-52, paras. 154-160), and multiple portable and mobile transmitters (2013 RF Order and Notice, 28 FCC Rcd at 3552-54, paras. 161-165), all with similarly defined terms, appearing in multiple places in the proposed rules (2013 RF Order and Notice, 28 FCC Rcd at 3601, App. B). This decision here combines these duplicate parallel summation processes into a single formula generally applicable across any sum of multiple exempt RF sources, as applicable. The combined formula does not affect the results of any of the 2013 proposals, rather it reduces the number of possible paths in summing the exemptions of RF sources by broadening the applicability of a single formula across multiple use cases.

¹⁶⁸ Multiple transmitters using the same physical antenna should be treated as multiple antennas at the same location.

¹⁶⁹ See 47 CFR § 1.1310.

60. The normalized contributions to the total exemption threshold can be determined by calculating for each RF source, whether mobile, portable, or fixed, the ratio of the maximum time-averaged power (matched conducted power or ERP, as appropriate) for the transmitter, comparing it to the appropriate frequency- and distance-dependent threshold using the formulas in either Table 1 or Table 2, and summing those ratios. If the ratios for all transmitters in a device operating in the same time-averaging period are included in the total sum and this sum is no more than one (*i.e.*, 100%), the cumulative contributions would not have exceeded the permissible limit and a location at a site or the device (*i.e.*, all transmitters within the device) would be exempt from routine evaluation.¹⁷⁰ All transmitters must be considered and all transmitters that can operate at the same time must be included in the summation of multiple transmitters. If a transmitter is subsequently proposed to be added under our permissive change authorization procedures for portable or mobile devices, a new calculation must be made including the additional transmitter.

61. The basic exemption criteria are contained in the *P* and *ERP* summation terms, while the *Evaluated/Exposure Limit* sum accounts for the preexisting exposure levels and correspondingly reduces the allowable margin remaining for exemption at the location of interest.¹⁷¹ For multiple antennas operating in the same time-averaging period, the summation formula above¹⁷² will apply as follows: sum the normalized contributions to the exemption threshold for each antenna by calculating the ratio of the maximum time-averaged P_i or ERP_j for the antenna to the corresponding exemption threshold $P_{th,i}$ or $ERP_{th,j}$, and then, summing these ratios, add any normalized contributions from RF sources with known exposure, (*i.e.*, the percentage of the relevant exposure limit that exists prior to considering the subject source(s)) at a specific location. If the total does not exceed one, the configuration is exempt.

62. Only Medtronic commented on the exemption summation proposal for portable or mobile devices, supporting the proposal but requesting that the Commission incorporate further technical definitions into its rules for terms used in the formula beyond those explicit in the *2013 RF Further Notice*. In particular, Medtronic requests definitions for the power quantities “maximum time-averaged ERP,” “available maximum time-averaged power,” and “delivered maximum time-averaged power.”¹⁷³ The use of maximum time-averaged power requires that the power (and corresponding maximum exposure) of multiple transmitters operating in the same time-averaging period be summed even if they do not transmit at the same instant (with or without overlapping transmissions) using the formula above. Because the exemptions rely on determination of available maximum time-averaged power and ERP, we are including definitions of “available maximum time-averaged power,” “effective radiated power (ERP),” and “time-averaging period” in the rules. However, because our exemptions do not rely on delivered power but available power, we decline to adopt a definition for “delivered maximum time-averaged power,” but we clarify here that the definition would be the largest net power delivered or supplied to an antenna, as averaged over a time period not to exceed 30 minutes for fixed sources, or as averaged over a time period inherent from the device transmission characteristics for mobile and portable sources (also not to exceed 30 minutes).

63. Medtronic also suggests that short time-averaging periods for non-overlapping transmission should be included in the rules.¹⁷⁴ We agree and further clarify that multiple source summations require time averaging over an averaging period during which the maximum power is being

¹⁷⁰ The sum of the quotient(s) of each absorbed power, ambient power density, or field strength squared and their respective SAR(s) or MPE(s) limit(s) for a particular frequency, also commonly referred to as “fraction of standard.” Note that this last summation term is due to RF sources not included in the exemption summations.

¹⁷¹ For example, for mobile RF sources, this location of interest would typically be at a separation distance of 20 cm.

¹⁷² See *supra* para. 59.

¹⁷³ See *2013 RF Order and Notice*, 28 FCC Rcd at 15166, para. 112 & nn.190-92.

¹⁷⁴ See Medtronic Comments at 5-6.

transmitted. These clarifications account for simultaneous transmissions while allowing for short time-averaging periods for non-overlapping transmissions,¹⁷⁵ provided that summations (or measurements) performed using a shorter time-averaging period correspond to the maximum aggregate time-averaged SAR or power density of the multiple transmitters being summed (*i.e.*, accounting for maximum duty cycle, maximum transmitted power, overlapping transmission, etc.). Also, short time-averaging periods (*e.g.*, over one pulse at maximum power) may be selected to conservatively determine power and avoid the need to sum powers from multiple transmitters when transmissions from the different transmitters do not overlap in time. The values for P_i , ERP_j , and $Evaluated_k$, where applicable, are determined according to the source-based time averaging requirements of Sections 2.1093(d)(5) and 2.1091(d)(2), and the sum of those values represents conservatively the total calculated exposure. This summation formula may be used even if some of the three terms do not apply (*i.e.*, where those terms would be zero). As the extent of overlapping transmissions may vary among individual products and host configurations, applicants may want to consult device-specific procedures developed by the FCC Laboratory addressing the details of how to perform evaluations and determine compliance.¹⁷⁶

64. There were relatively few other comments directly addressing the proposed summation formula for the exemption of multiple fixed transmitters. While it did not object to the formula, Verizon considered each of the methods/summation terms as representing an independent method to determine exemption and suggested that different methods could be used for different sources, as appropriate, in determining the contribution of individual transmitters at a multiple transmitter site.¹⁷⁷ In response, Boston & Philadelphia argued that, in the interest of simplicity and consistency, all wireless providers at any particular site should agree upon a single method.¹⁷⁸ Motorola commented that the Commission should be clear that a single transmitter should only be counted once in the summation formula.¹⁷⁹ H&E presumed that measurements were required to establish the evaluated summation term and suggested simply measuring the actual exposure to avoid the possibility of counting a single source more than once.¹⁸⁰ In the modified exemption summation formula we adopt here, which differs from our 2013 proposal, we address commenters' concerns by making each term in the consistently applied summation approach representative of either one of the independent methods of exemption or an evaluation. We emphasize here that parties who may wish to apply different reasonable summation methods may do so, but such methods would not be considered as an exemption as described in our rules; instead, an

¹⁷⁵ See 2013 RF Order and Notice, 28 FCC Rcd at 3502, para. 8 & n.10 ("Exposures due to multiple transmitters are considered 'simultaneous' if these exposures occur in the same time averaging period. For example, for two variable power consumer transmitters averaged over the same source-based time averaging period, the exposure based on the time-averaged SARs must be summed even though either transmitter may not necessarily be transmitting at the same instant. In principle, time averaging periods up to 30 minutes could be required; however, shorter time averaging periods less than 30 minutes are permitted, and in fact are required for mobile and portable consumer devices, to avoid redundant or repetitive measurements, provided that measurements performed using a shorter time averaging period result in the maximum aggregate time-averaged SAR of the multiple transmitters being summed (*i.e.*, accounting for maximum duty cycle, maximum transmitted power, overlapping transmission, etc.). Alternatively, short time averaging periods (*e.g.*, over one pulse at maximum power) may be selected to conservatively measure SAR and avoid the need to sum SARs from multiple transmitters during non-overlapping transmission.").

¹⁷⁶ See *infra* Section V.C, Transmitter-Based and Device-Based Time-Averaging (we seek comment on how applications of these exemption criteria and accounting for overlapping transmissions and time-averaging periods might be either similar or different in the context of transmitter/device-based time-averaging).

¹⁷⁷ See Verizon Comments at 8-9.

¹⁷⁸ See Boston & Philadelphia Reply at 5.

¹⁷⁹ See Motorola Comments at 7.

¹⁸⁰ See H&E Reply at 3.

alternative summation approach that appropriately demonstrates compliance would be considered a routine RF exposure evaluation.

65. We find that there is no reason or circumstance for which a transmitter should be counted more than once in the overall sum for any particular exposure location. At a proposed site with higher-power fixed transmitters, only the *ERP* summation terms would normally be used. At an existing site with known exposure levels, the *Evaluated* third term in the total sum would appropriately reduce the margin for (any new) transmitters claiming *ERP* exemption. This should be most useful when a fixed transmitter is being added to a dense antenna facility. Where existing exposures collectively are not significant,¹⁸¹ the *Evaluated* third term in the summation may be disregarded.¹⁸² For low-power fixed transmitters, the *P* exemption summation term will typically be less restrictive where applicable than the *ERP* exemption term and the margin would be reduced where necessary based on existing SAR evaluation data. The *P* and *Evaluated* terms may be most commonly used in situations where, for example, multiple transmitter modules are installed in a small device. As far as the discussion by commenters of various summation methods, the method we adopt is simple, consistent, and conservative. In addition, just as the methods for determining exemption from routine evaluation are not the only means to demonstrate compliance with the RF exposure limits, other more sophisticated methods of adding contributions from multiple transmitters are acceptable if based on sound engineering practice, but these alternative procedures would be considered as part of an RF exposure evaluation demonstration rather than an exemption.

(ii) RF Sources without Fixed Physical Relationships

66. In determining the availability of an exemption, we will not require applicants to account for multiple RF sources that have no fixed positional relationship between or among each other, as is typically the case between a mobile and a broadcast antenna or other fixed source or between two mobile sources.¹⁸³ There is no practical method to quantitatively establish exemption for multiple RF sources where there is no definite positional relationship between sources, such as between multiple mobile/portable devices or between such devices and fixed transmitters. None was recommended by commenters.

67. While certain commenters raised concerns about the effect of cumulative RF exposure, we find that consideration of the typical spatial separation between RF sources diminishes the practical relevance of multiple spatially uncorrelated transmitters.¹⁸⁴ Exposure from fixed RF sources will vary considerably in different environments that contain a portable or mobile device, depending on location relative to that fixed RF source. Additionally, since exposure diminishes exponentially with increasing distance, signal losses occur due to non-line-of-sight conditions from distant sources, and separation from fixed sources is typically large, exposure from fixed RF sources is normally much less than the limit and

¹⁸¹ See 47 CFR § 1.1307(b)(3) (“In general, when the guidelines specified in § 1.1310 are exceeded in an accessible area due to the emissions from multiple fixed transmitters, actions necessary to bring the area into compliance are the shared responsibility of all licensees whose transmitters produce, at the area in question, power density levels that exceed 5% of the power density exposure limit applicable to their particular transmitter or field strength levels that, when squared, exceed 5% of the square of the electric or magnetic field strength limit applicable to their particular transmitter.”).

¹⁸² *Id.* Greater than 0.05 (5%) is considered significant.

¹⁸³ See 2013 RF Order and Notice, 28 FCC Rcd at 3546-47, paras. 142-44.

¹⁸⁴ B. Blake Levitt & Henry C. Lai (Levitt/Lai) Comments at 14; Hubert Comments at 3 (expressing concern about the cumulative effect of exposure from many sources even where the total exposure is far below our exposure limits). Further, Sections 1.1307(c) and (d) of the Commission rules require further environmental processing if the staff determines, on its own or based upon the allegations of an interested party in a written submission, that the particular use of a device ordinarily exempt from RF exposure routine evaluation exceeds the applicable exposure limits.

contributes negligible exposure virtually all the time, and we expect that exposure from devices near a person's body would generally be overwhelmingly more significant. More simply, we expect that the locations of maximum SAR in the body from different RF sources that are proximate to the body are highly unlikely to overlap, precisely because when the RF sources are close to the body they will be exposing smaller areas of the body and separated sources will accordingly expose different areas of the body without overlap. We conclude that for these reasons, the summation of potential exposure due to spatially uncorrelated sources should not be routinely required and our conclusion is consistent with all known compliance activities to date.

68. Also, we note that the exposure from each portable or mobile device near a person will generally involve low total power absorption while being highly localized and will not result in significant contributions to whole-body average SAR. Thus, for multiple exempt RF sources without an inherent spatial relationship, regardless of their classification as fixed, mobile, or portable, it is very unlikely the localized or whole-body SAR limits would be exceeded.¹⁸⁵

B. Environmental Evaluation

69. For fixed RF sources where an exemption cannot be invoked, a routine environmental evaluation—described in our rules as a “determination of compliance”—must be performed to ensure that the exposure limits are not exceeded in places that are accessible to people. In the great majority of cases, such an evaluation is simple and generic and does not require a determination of the precise exposure level, only that it can be determined from the information available that any potential of RF exposure is less than our limits. In other cases, the evaluation may be more complex, requiring more precision with regard to transmitter power and antenna distance from a space that persons can access. In such cases, the benefit of protecting humans from RF emissions causing exposures in excess of our existing limits outweighs the costs that may be associated with such evaluation.

70. The rapidly evolving technology of mobile and portable devices and the evaluation and testing technology associated with RF exposure of such devices require that the equipment authorization process be updated to reflect such changes. As proposed in the *2013 RF Further Notice*, we remove from our rules provisions that specify acceptable approaches to evaluation and will instead allow any valid computational method to be used in demonstrating compliance with our RF exposure limits.¹⁸⁶ OET Bulletins and the KDB will describe acceptable methods for particular applications, and applicants can request use of other computational or measurement methods whose reliability and validity they can substantiate to the satisfaction of OET staff.¹⁸⁷ As proposed,¹⁸⁸ we also eliminate a minimum measurement distance of 5 cm for devices operating above 6 GHz, since this requirement appears to have been rendered obsolete by technological developments and is no longer necessary.¹⁸⁹

1. Consistency in Usage of Any Valid Method for SAR Computation

71. We adopt our proposal to modify the language in sections of our rules¹⁹⁰ to allow any valid computational method by removing specific references to finite difference time domain (FDTD).¹⁹¹

¹⁸⁵ No commenter suggested any way, practical or not, to determine when and how to exempt sources for such situations.

¹⁸⁶ See *2013 RF Order and Notice*, 28 FCC Rcd at 3555, para. 168. The relevant sections to be amended are 47 CFR §§ 1.1307(b)(4)(iv), 95.1221.

¹⁸⁷ 47 CFR § 2.947(a)(3).

¹⁸⁸ See *2013 RF Order and Notice*, 28 FCC Rcd at 3556, para. 170.

¹⁸⁹ See *infra* para. 73.

¹⁹⁰ While we adopt our proposal to modify the language in Section 95.1221, as they appeared in the *2013 RF Order and Notice*, we note that some of those rule numbers have changed in the interim (e.g., the Part 95 rules were

(continued....)

In the 2013 *Order*, the Commission corrected an inconsistency in the rules to allow either computation or measurement for medical devices in both sections 95.1221 and 1.1307(b)(2) of our rules, but continued to require the FDTD method when computation is used.¹⁹² In the 2013 *RF Further Notice*, we proposed to allow any valid computational method by removing from our rules the reference to this specific method.¹⁹³ To ensure validity, our rules will require that computational modeling be supported by adequate documentation showing that the numerical method as implemented in the computational software has been fully validated.¹⁹⁴ In addition, the equipment under test and exposure conditions must be modeled according to protocols established by FCC-accepted numerical computation standards or available FCC procedures for the specific computational method.”¹⁹⁵

72. Most parties support this specific proposal to allow numerical methods other than FDTD, and we continue to find that this is the appropriate rule.¹⁹⁶ B. Blake Levitt and Henry C. Lai (Levitt/Lai), who focus on fixed sites, propose an increased reliance on field measurement rather than computation, expressing concern that SAR computation would underestimate exposure, but do not provide an empirical basis for this assertion.¹⁹⁷ In our experience, computational methods for transmitter facilities are generally more restrictive than measurements because computations typically use maximum power and other conservative assumptions. Therefore, actual measurements often result in lower exposure values due to these conservative assumptions often employed in computational methods, but using maximum power and other conservative assumptions can provide a simpler, less burdensome means of demonstrating compliance and will continue to be permitted where they can be successfully supported.¹⁹⁸ Medtronic supports our proposal but also seeks clear guidance for software developers about the requirements for valid software.¹⁹⁹ OET will continue to update the KDB to provide appropriate guidance on acceptable methods of computation with accepted numerical computation standards or procedures for specific computational methods.

2. Removal of Minimum Evaluation Distance Requirement from Rules for Frequencies above 6 GHz

73. In the 2013 *RF Order and Notice*, we proposed²⁰⁰ to remove the 5-cm minimum separation specification for measurements and calculations used to demonstrate compliance for devices

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renumbered as part of the 2017 *Report and Order*). The numbers modified hereby are identified in Appendix A. See §§ 1.1310(d)(1), 2.1093(d)(2), and 95.2585, Appendix A *infra*.

¹⁹¹ See *Order granting ANSYS Inc. Request for Waiver of 47 CFR § 1.1307(b)(2) of Commission Rules*, ET Docket No. 10-166, Order, 26 FCC Rcd 1034 (2011).

¹⁹² See 2013 *RF Order and Notice*, 28 FCC Rcd at 3517, para. 51 (2013).

¹⁹³ See *id.* at 3555, para. 168.

¹⁹⁴ Fully validated means that a method has been tested and shown to provide results equivalent to those derived from already accepted methods for the same canonical device(s). See also CDE Comments at 2. As cautioned by CDE, we will require that to be valid, any SAR computation method must be clearly documented and shown to produce consistent results

¹⁹⁵ See *infra* Appx. A; see also 47 CFR §§ 1.1310, 2.1093(d)(1).

¹⁹⁶ See TIA Comments at 22 (supports the proposal and endorses the use of IEEE and IEC standards for validation of computational methods); Medtronic Comments at 6; CDE Comments at 2.

¹⁹⁷ See Levitt/Lai Comments at 7 and 29.

¹⁹⁸ In the case of a dispute or a credible concern, in practice, the ultimate determination of compliance will continue to be based on FCC measurements.

¹⁹⁹ See Medtronic Comments at 6.

²⁰⁰ 2013 *RF Order and Notice*, 28 FCC Rcd at 3556, para. 170.

operating above 6 GHz from Section 2.1093(d) of our rules.²⁰¹ We adopt our proposal. The 5-cm minimum separation distance has been superseded by technological developments that provide for uses with transmitting elements closer to the body, and to the extent any portable devices are operating above 6 GHz, the measurement distance should be reflective of normal use conditions. Consumers for Safe Cell Phones (CSCP) supports the proposal as one that will better simulate RF exposure in typical situations,²⁰² and we draw the same conclusion. Applicants must provide specific justification for measurement distances used in compliance testing, describing the normal and feasible usage(s) of the device, and certification review will specifically include evaluation of the propriety of this specification, including any measures that may be taken to ensure that it is maintained.

3. Technical Evaluation References in Rules

74. In the *2013 RF Order and Notice*, we included in our rules a reference to the OET KDB in place of a specific (now outdated) external technical reference to IEEE Std C95.3-1991 as a possible SAR evaluation reference.²⁰³ In doing so, we committed to providing ongoing guidance on technical evaluation procedures and standards. In the *2013 RF Further Notice*, we proposed to remove external technical evaluation references elsewhere within our rules generally, and to specifically remove reference to IEEE Std C95.3-1991 in Section 24.51(c).²⁰⁴ We adopt that proposal.

75. There remains general support for providing ongoing policy guidance consistent with advances in the engineering state of art of the field in the KDB rather than specifying specific standards in the Commission's rules. Like the OET Bulletins, the guidance in the KDB is not binding on the applicant or the Commission, and other evaluation methods may be used if they can be shown to be valid. We also recognize that expedited approval of devices by Telecommunications Certification Body (TCB) necessarily involves the use of uniform evaluation procedures as established using the KDB.²⁰⁵ As such, we have already been successfully implementing the recommended procedural changes for KDB documents of general applicability.

²⁰¹ See 47 CFR § 2.1093(d) (requiring a minimum separation distance of five cm for measurements and calculations used to demonstrate compliance for devices operating above 6 GHz). With the development of portable devices such as notebook and tablet computers with wireless modules transmitting in the 60 GHz frequency range, it is possible that these devices will be used close to the body. In such cases, we have required measurements at closer distances where usage indicated that this is a more realistic representation of the exposure distance, see FCC ID: PD918260NG (wireless module installed in a notebook computer), and FCC ID: PD918265NG (wireless module installed in a tablet computer). There has been substantial improvement in applying numerical simulation techniques for RF exposure over the last two decades, which is useful for close-in determinations, and applicants for equipment authorization have successfully applied a combination of numerical simulation and measurement methods to determine power density at these distances to demonstrate compliance. Also, a miniature electric field probe supported by a SAR measurement system capable of making mmWave power density measurements up to approximately 90 GHz at 2 mm or more from wireless devices is now commercially available.

²⁰² See CSCP Comments at 2. No other party commented on this proposal.

²⁰³ See *2013 RF Order and Notice*, 28 FCC Rcd at 3510-13, paras. 28-41; see also 47 CFR § 2.1093(d)(3).

²⁰⁴ See *2013 RF Order and Notice*, 28 FCC Rcd at 3556-57, paras. 173-74.

²⁰⁵ See 47 CFR § 2.907. Under Section 302(e) of the Communications Act, 47 U.S.C. § 302a(e), the Commission is authorized to delegate its equipment testing and certification functions to private organizations. In 1998, the Commission adopted rules allowing accredited TCBs to approve most types of equipment that require certification. *1998 Biennial Regulatory Review—Amendment of Parts 2, 25 and 68 of the Commission's Rules to Further Streamline the Equipment Authorization Process for Radio Frequency Equipment, Modify the Equipment Authorization Process for Telephone Terminal Equipment, Implement Mutual Recognition Agreements and Begin Implementation of the Global Mobile Personal Communications by Satellite (GMPCS) Arrangements*, GEN Docket No. 98-68, Report and Order, 13 FCC Rcd 24687, 24703, para. 32 (1998).

76. This proposal received significant comment from Motorola, CDE, Nokia Corporation (Nokia), and Mobile & Wireless Forum (MWF).²⁰⁶ While Motorola supports use of the KDB for this purpose, it expressed some concerns about process and transparency, suggesting that the KDB has the potential to compromise notice-and-comment rulemaking process.²⁰⁷ Similarly, MWF and Nokia recommended a process for the development of KDB documents that would involve release of a draft with opportunity to comment, adequate transition period, harmonization to the extent possible with international standards and practices, and flexibility for innovation in both testing and technology.²⁰⁸ With respect to these suggestions, and as Motorola points out,²⁰⁹ the FCC Laboratory now issues draft versions of KDB guidance documents and engages manufacturers and other affected entities early in the revision process,²¹⁰ and that the guidance provides flexibility and the opportunity to harmonize FCC standards with existing standards where practical. These procedures effectively address commenters' concerns regarding process and participation, and the ongoing and responsive nature of the KDB should result in better "readability" and usability than rules we might otherwise adopt. And, we stress again, the KDB process consists of up-to-date expert guidance by our staff and is nonbinding, thus preserving the option of raising any concern or disagreement with the Commission.²¹¹

77. Commenters generally prefer the Commission's approach of providing guidance in the KDB as opposed to specifying it in the Commission's rules, although they note various ways that the KDB process could be improved. Motorola suggests that the Commission should consider improvements to the process, even as it acknowledges that OET has taken steps to engage the affected entities in the process of KDB revision and update in general.²¹² CDE suggests that the Commission maintain and update OET Bulletins 56 and 65 but keep the material readable for the public. CDE also expresses concern about process and content for the KDB, asking about what recourse there is in the case of doubts about KDB materials, the potential impact of future personnel or organizational changes on the quality of the KDB, and whether the material is useful and readable for the public at large.²¹³ At this time, we decline to address these suggestions for improvement of the KDB process.

78. We acknowledge the support of MWF and Nokia for the incorporation of international evaluation standards in the KDB and are mindful of the Office of Management and Budget (OMB) Circular A-119, which encourages federal participation in the development and use of voluntary consensus standards and in conformity assessment activities, to which they refer.²¹⁴ Contrary to Nokia's suggestion, we decline to implement a presumption in favor of the adoption of standards from a standards committee simply because Commission staff sit on that committee. While Commission staff has been and will continue to be involved in standards committees, its availability to participate is not constant, and

²⁰⁶ Formerly Mobile Manufacturers Forum (MMF).

²⁰⁷ See Motorola Comments at 8.

²⁰⁸ See MWF Comments at 3-4; Nokia Comments at 5-6.

²⁰⁹ See Motorola Comments at 8.

²¹⁰ See <https://apps.fcc.gov/oetcf/kdb/reports/PublishedDocumentList.cfm>; draft publications of the OET Laboratory Division are available at that website, including proposed guidance intended for KDB publication and tutorial presentations, along with means for submitting public comments. The public is invited to make comments and provide suggestions to the documents made available at this page. At the end of the comment period, revised documents may be published, withdrawn or modified and submitted for additional review.

²¹¹ Since the inception of the KDB process, the FCC Laboratory has issued myriad guidance documents on technical issues regarding equipment authorization. The Commission has not received any complaint regarding any of the guidance provided and or the process itself.

²¹² See Motorola Comments at 7-8.

²¹³ See CDE Comments at 4.

²¹⁴ See https://www.whitehouse.gov/omb/circulars_a119/.

when it does participate it would be premature to assume FCC validation of such standards. As stated in OMB Circular A-119, “agency participation in standards bodies does not connote agency endorsement or agreement with decisions by such bodies.” In evaluating whether to use a standard, which is done on a case-by-case basis, an agency needs to consider several factors to determine if it is effective and otherwise suitable for meeting the regulatory needs of the Commission, including our review of it in light of notice and opportunity to comment. Further, we also modified our rules for measurement procedures to make it clear that “any measurement procedures acceptable to the Commission may be used to prepare data demonstrating compliance with the requirements of this chapter.”²¹⁵

79. We agree that OET Bulletins 56 and 65 have been useful but need to be updated. To avoid confusion, we will eliminate Bulletin 56 in its present form in deference to more current material on the same subject on the Commission’s website. The staff will maintain and update OET Bulletin 65 as a stand-alone document available for download.

C. Mitigation Measures to Ensure Compliance with Exposure Limits

80. While the purpose of evaluation is to establish whether there is a spatial region or area near transmitting antennas where the RF exposure limits are exceeded, the purpose of mitigation is to take the appropriate steps to keep persons out of that space. With the proliferation of wireless base stations that are increasingly smaller in size, sometimes concealed or camouflaged, and often located close to where persons pass, linger, or work, additional measures are needed to ensure that exposure in excess of our general population limits is permitted only for those with proper training and capability to limit their exposure. Such post-evaluation mitigation measures include labels, signs, markings, barriers, positive access controls, and occupational training.²¹⁶ Mitigation requirements depend on the physical characteristics of the area and the level of exposure above the pertinent limits. These measures range from precluding members of the general public from entering areas where exposure exceeds the general population continuous limit (general population / uncontrolled), to measures allowing only trained workers to enter an area that exceeds the continuous occupational limit either briefly, with protective clothing, or with an exposure monitor so that compliance with the occupational limit with 6-minute time averaging is maintained (occupational/controlled) environments. This pertains primarily to fixed sites; mitigation measures for mobile and portable devices are typically based on device features such as proximity sensors or device-controlled time averaging.²¹⁷

81. Our existing rules address mitigation in general terms but lack specificity about how to prevent access to spatial regions where the RF exposure limits are exceeded and what measures (i.e. access restriction, signage, and training) should be considered adequate. Given the proliferation of antennas, changes in siting practices, and our consequent experience and that reflected in the record as responses to our initial proposals in the *Notice*, the *2013 RF Further Notice* proposed specific access restriction, signage, and training requirements for fixed transmitter sites where exposure limits may be exceeded, considering recent standards activity working toward defining industrial RF safety programs.²¹⁸

²¹⁵ 47 CFR §2.947(a)(3). The rules permit the use of any advisory information regarding measurement procedures that can be found in the KDB, but also permits parties to submit alternatives.

²¹⁶ *Positive access control* includes locked doors, ladder cages, or effective fences, as well as enforced prohibition of public access to external surfaces of buildings, or generally, affirmative physical measures for preclusion of unauthorized access. It does not include natural barriers, which might limit access effectively in some, but not all cases, or other access restrictions that did not require any action on the part of the licensee or property management.

²¹⁷ See *supra* para. 14; *infra* Section V.B.

²¹⁸ Since the *2013 RF Order and Notice*, IEEE has produced a revised version of its 2005 standard, IEEE C95.7-2014, which closely matches our proposals.

1. Transient Exposure

82. Currently, our rules provide that occupational exposure limits could apply to untrained persons, provided that the exposure is “transient” and they are informed of the exposure potential and the appropriate means to mitigate their exposure.²¹⁹ In the *2013 RF Further Notice*, we noted that these rules lacked the requisite clarity and could be interpreted in different ways.²²⁰ To address this, we proposed to define transient exposure as brief exposure in a controlled environment that does not exceed the general population limit, which may be averaged over a time interval up to 30 minutes long, and to limit transient exposure to the continuous occupational limit at any time.²²¹

83. We adopt our proposed definition of transient exposure as the brief exposure in a controlled environment that does not exceed the general population limit, which may be averaged over a time interval up to 30 minutes.²²² However, we do not adopt our proposal that transient exposure should not exceed the continuous occupational limit at any time.²²³ As H&E contends, our proposal to limit transient exposure above the occupational limit “at any time” would result in a more restrictive exposure limit for transient individuals than for the general public for which there is no temporal peak limit.²²⁴ Our present rules limiting exposure for all populations do not specify a cap at any peak value above the continuous limits.²²⁵ As long as the average exposure over any applicable time-averaged period provided in our rules is compliant with the continuous general population limit, a transient individual walking in a controlled area may be exposed above the general population limit in one location and below this limit in another location. Our rules do not specify how much above that general population limit an instantaneous exposure is permitted to be.

84. The National Association of Broadcasters (NAB) asserts that all aspects of occupational exposure should apply to transient persons, including the 6-minute averaging time applicable for occupational exposure.²²⁶ We emphasize here, however, that despite NAB’s interpretation, the time-averaging period for transient persons is up to 30 minutes, per our rules²²⁷ and per the NCRP Report cited in our rules, which forms in part the basis of our exposure limits.²²⁸ As we stated previously, shorter

²¹⁹ 47 CFR § 1.1310(e)(1).

²²⁰ See *2013 RF Order and Notice*, 28 FCC Rcd at 3557, para. 177 *et seq.*

²²¹ *2013 RF Order and Notice*, 28 FCC Rcd at 3558, para. 181.

²²² Numerous commenters expressed support for the adoption of the proposal. See Portland Comments at 4; UTC Reply at 7; Boston Reply at 6.

²²³ Our continuous *exposure limits* are the values listed in 47 CFR § 1.1310 without consideration of averaging time and may not be exceeded over an indefinite period of time but may be exceeded over shorter definite time periods given consideration of time averaging. The continuous exposure limits are generally used to define the boundaries of controlled areas where “behavior-based” time averaging may be necessary. We generally refer to simply the “exposure limit,” when “behavior-based” time averaging is not considered.

²²⁴ See H&E Reply at 3.

²²⁵ See SiteSafe Comments at 2; H&E Reply at 3; Tell Comments at 2 (arguing against limiting transient exposure to the continuous occupational limit at any time, as it would make the Commission’s interpretation of transient exposure limits in the *2013 RF Order and Notice* more restrictive than the public exposure limits, by precluding peak levels in excess of the occupational limit even if the time-averaged level is below the public limit).

²²⁶ See NAB Comments at 5-7; 47 CFR § 1.1310(b), (e).

²²⁷ See 47 CFR § 1.1310(e), tbl. 1.

²²⁸ See NCRP Report No. 86, Section 17.4.3: *Time Averaging for the General Population*: “... the 30-min time-averaging period is responsive to some special circumstances for the public at large. Examples are transient passage by the individual past high-powered RFEM sources, and brief exposure to civil telecommunications systems.”

averaging times can also be used during evaluation; while they are generally more conservative, they may provide convenience.²²⁹

85. Global RF Solutions (Global RF) expresses concern about the use of the term “general population” in conjunction with “controlled,” arguing that a person can be ‘Controlled’ or ‘Uncontrolled’ but not both.²³⁰ We are not convinced that these concerns over the terminology, and how it is applied, are valid. There are only two sets of limits—those which apply to supervised/trained workers (in an occupational setting) and those which apply to the general population (which includes unsupervised and untrained workers).²³¹ The environment in which these exposures occur defines whether the exposure is in a controlled or uncontrolled setting.²³² By definition, a controlled environment is an occupational setting. Because we are also adopting requirements for implementing RF safety programs at fixed sites, the only situation where transient exposure would be relevant is in a controlled setting.

86. The rules we adopt today will require, for controlled areas where the general population limit is exceeded, access controls and appropriate signage in addition to supervision of transient individuals by trained occupational personnel.²³³ NAB and Motorola Solutions, Inc. (Motorola) both argue that the Commission’s requirements that transient individuals be supervised are unnecessary, burdensome, and not practical or effective.²³⁴ We disagree. The supervision requirement is reasonable because it ensures that within a controlled area exposure above the general public limits is only transient. These new rules address the concerns of EMR Policy Institute (EMRPI) about making transient individuals aware when they enter (and leave) areas where exposure exceeds the general population limits.²³⁵ For the case of visitors to a controlled site, again, normal familiarization procedures, such as pointing out the meaning of RF signs and boundaries would constitute adequate awareness. Such activities could avoid exceeding the general population limit with time averaging during orientation while supporting an awareness so that occupational limits would apply to subsequent independent activity.

87. We find no basis for permitting exposure of any untrained individuals—regardless of whether they are workers—greater than the general population exposure limit. The applicability of occupational limits requires that a person is fully aware and able to exercise control over his or her work-related exposure.²³⁶ Thus, the occupational exposure limits apply only if a person has been trained and has sufficient information to be fully aware of the nearby RF sources and the necessity and means of avoiding overexposure. To satisfy the requirement to present written or oral information to untrained

²²⁹ By applying a 30-minute time average to transient individuals, it is also theoretically possible for RF sources operating below 1.34 MHz that a transient individual could actually be permitted to be exposed to higher fields during some parts of a time period between 6 and 30 minutes than would a worker, because our occupational and general population limits are identical at these frequencies. We do not anticipate that this would occur in practice, however, especially given that RF safety programs designed for worker protection would normally be held to the continuous occupational exposure limit, but it reinforces the need for transient individuals to be supervised.

²³⁰ See Wessel Comments at 1-2.

²³¹ See NCRP Report No. 86, Section 17.4.1: *Occupational Exposure Criteria*, and Section 17.4.2: *General-Population Exposure Criteria*. “[I]ndividuals exposed in the work place should be relatively well informed of the potential hazards associated with their occupation. Furthermore, these workers may have the opportunity to make personal decisions in regard to their exposure, based on the relative risk as they perceive it. Individuals subjected to [RF exposure] outside the work place are generally unaware of their exposure, and furthermore, if they are aware, they rarely have the option to reduce their level of exposure.”

²³² See 1996 Order, 11 FCC Rcd at 15136, para. 35.

²³³ See *infra* Appx. A.

²³⁴ See NAB Comments at 7-8; Motorola Comments at 9 (questioning what qualifies as “supervision”).

²³⁵ See EMRPI Comments at 8.

²³⁶ See 47 CFR § 1.1310.

transient individuals within controlled environments, we affirm that written information may include signs, maps, or diagrams showing where exposure limits are exceeded, and oral information may include prerecorded messages.

88. RF Check contends that any workers, including contractors and employees of licensees, electricians, roofers, flashers, painters, HVAC personnel, maintenance workers, firefighters, and utility workers, who must perform any task or stop in an area that exceeds general population limits must not be considered transient and must be trained.²³⁷ OSHA shared similar concerns as they related to third-party workers who have not received training and may be unaware they are working near RF sources on rooftops and buildings.²³⁸ We agree with OSHA and RF Check that third-party workers who perform tasks near RF sources must be trained and are not considered transient. With rare exceptions, anyone who might enter an area where the general population limits are exceeded should have already received RF awareness training prior to accessing the area.²³⁹ As the NCRP Report provides, transient provisions are not to be used with any regularity and so would not apply to persons expected to be in locations for extended periods where the general population limits are exceeded (tree trimmers, window washers, etc.), nor to persons who traverse such an area on a regular basis, such as an employee parking lot or walkway; rather, all such persons must receive appropriate training.²⁴⁰

2. Signage and Access Control

89. There are various effective means to achieve compliance with the RF exposure limits. Those include signs, roof markings, barriers, exposure level maps, and positive access control. Under the rules we adopt today, signs are not required *per se* and not all signs are applicable to all services or situations. Specifically, we will require licensees and operators of fixed RF sources to use signs when the RF source or combination of RF sources in the same area create locations where exposure is above the limit for the general public. We also allow alternatively the use of indicators (*e.g.*, chains, railing, paint, and diagrams) as well as the option to affix signs directly to the surface of an antenna, particularly in situations where positive access controls are in place to effectively restrict access only to persons who are trained (*e.g.*, on a rooftop with a locked door) in areas within where the public limits are exceeded (Category Two and above).

90. We adopt four categories for specifying RF safety program actions, as proposed, *i.e.*, *Category One* through *Category Four*, which reflect the potential RF exposure scenarios. For a visual

²³⁷ See SiteSafe Comments at 2; RF Check Comments at 2-4.

²³⁸ See Letter from William Perry, Director, Directorate of Standards and Guidance, Occupational Safety and Health Administration, to Julius Knapp, Chief, FCC Office of Engineering and Technology at 3, (July 1, 2015) (OSHA Letter).

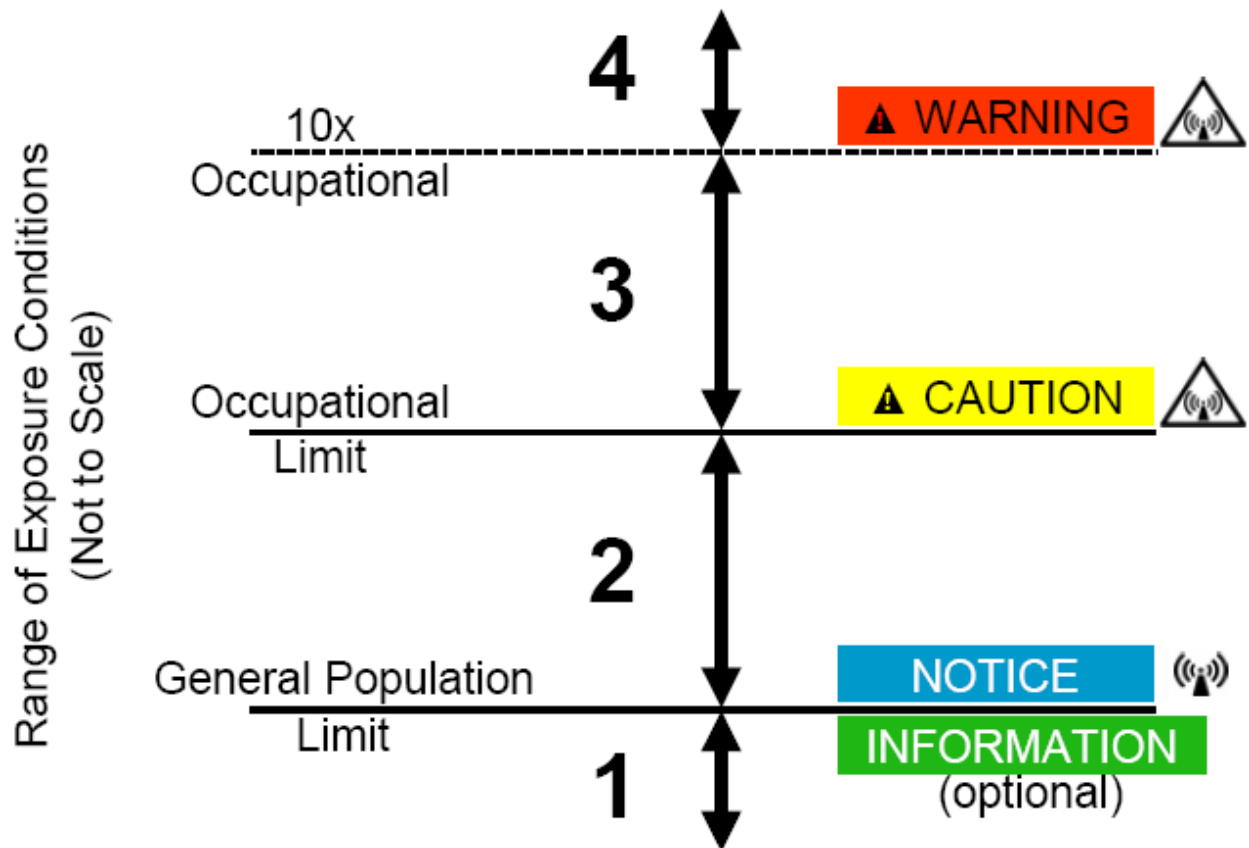
²³⁹ Although we are allowing a brief higher exposure coupled with control of some aspect of a transient person's behavior as a result of supervisory instruction that is given in such a way as to maintain compliance with the general population limit, it is the licensee's responsibility as part of its RF safety program to manage compliance in the event that persons (either trained or supervised) are permitted access to areas of their site with the potential to exceed the general population exposure limit.

²⁴⁰ See NCRP Report No. 86, Section 17.4.4: *Special Circumstances for Population Exposure*:


It is recognized that there are special circumstances in which the exposure limits for the general population may unnecessarily inhibit activities that are brief and non-repetitive. For example, the presence nearby of a number of emergency vehicles engaged in telecommunications might cause a brief exposure to fields at strengths above the general-population limit. Because only small groups of the population would be exposed under these conditions, and almost certainly not on a repeated basis, the occupational exposure levels are permitted for such cases.

depiction of these categories, refer to Figure 1 below.²⁴¹

Figure 1. Graphical Representation of Exposure Categories and Associated Signage Requirements



NOTE 1: Where immediate and serious injury would occur on contact regardless of category,

▲ DANGER  the following sign components are required pursuant to the description of *Category Four* in paragraph 91.

NOTE 2: Drawn from IEEE Std C95.7-2014 and IEEE Std C95.2-1999.

91. Determination of the appropriate Category Two, Three, or Four signage must be based on a specific site evaluation, consistent with our existing recommendations and rules for routine evaluation of compliance by measurement or computation.²⁴² The standardized signage we adopt in this *Order* is intended to apply to all exposure situations in which they are used, so that when signs are used they conform to the specification provided in this *Order*. The following information must be included in a sign, in addition to those specifically identified per each category level below:²⁴³

- RF energy advisory symbol (*e.g.*, Figure A.3 of C95.2-1999)

²⁴¹ These categories are analogous to the subsequently modified IEEE Std C95.7-2014. *See* Figure 1 of IEEE Std C95.7-2014 in comparison with Figure 1 of IEEE Std C95.7-2005.

²⁴² *See* OET Bulletin 65, *supra* n. 60.

²⁴³ Section 2.4 of the National Association of Broadcasters Engineering Handbook, 10th Edition; *see also* CDE Comments at 2.

- A description of the RF source (*e.g.*, transmitting antennas)
- Behavior necessary to avoid over-exposure (*e.g.*, do not climb tower unless you know that antennas are not energized; stay behind barrier or off of markings)
- Up-to-date contact information (*e.g.*, monitored phone number or email address connected to someone with authority and capability to provide prompt response).

92. Category One signage applies to locations where RF sources do not cause continuous or source-based time-averaged exposure in excess of the general population limit in Section 1.1310. Category One signs are optional and will show a green “INFORMATION” heading. These Category One signs may be used to offer information to the public that a transmitting RF source is nearby but that it is compliant with the Commission’s exposure limits regardless of duration or usage. Specifically, the sign could provide an explanation of safety precautions to be observed when closer to the antenna than the information sign (where applicable), a reminder to obey all postings and boundaries (if higher categories are nearby), and up-to-date licensee (or operator) contact information (if higher categories are nearby), or a place to get additional information (such as a website, if no higher categories are nearby).

93. AICC argues that the Category One sign is “dangerous and non-productive” because the public may interpret it as indicating a problem when there is none.²⁴⁴ To the extent AICC is concerned that a Category One sign would indicate a problem where none exists, our rules already offer a simple solution: don’t post one. Deploying Category One signs is voluntary. Still, there are situations in which some installations might warrant the use of Category One signs, for example, if the location where sign placement is feasible is not adjacent to the boundary where the general population exposure limit is exceeded,²⁴⁵ the “NOTICE” sign would provide awareness while avoiding oversignage.

94. Category Two signs and positive access controls are required where the continuous exposure limit would be exceeded for the general population, but not for occupational personnel. Category Two signs must have the signal word “NOTICE” in blue color. We allow under certain controlled conditions, such as on a rooftop with limited access (*e.g.*, a locked door with appropriate signage or antenna concealment), that a sign be attached directly to the antenna.²⁴⁶ A sign attached directly to an antenna will be considered sufficient only if it specifies a minimum approach distance and is readable from the direction of approach and at least at the separation distance required for compliance with the general population exposure limit in Section 1.1310. Appropriate training is required for any occupational personnel with access to the controlled area where the general population exposure limit is exceeded, and transient individuals must be supervised by occupational personnel with appropriate training upon entering any of these areas. Use of time averaging is required for transient individuals in the area where the general population exposure limit is exceeded. Though not required, use of personal RF monitors in the areas where the general population exposure limit is exceeded is an option to ensure compliance.

95. Category Three applies to locations where the exposure limit for occupational personnel would be exceeded potentially by no more than a factor of ten. Category Three requires signs with the appropriate signal word “CAUTION” in yellow color, and controls or indicators (*e.g.*, chains, railings, contrasting paint, diagrams), in addition to the positive access control established for Category Two, surrounding the area in which the exposure limit is exceeded. Under conditions where positive access controls are in place to effectively restrict access only to authorized persons in areas where the public limits are exceeded, we allow a sign to be attached directly to the antenna, and further we allow controls

²⁴⁴ See AICC Reply at iii, 19 (claiming that the “Category One signage constitutes negative declaration of something that the consumer has not linked to the security system in their home or business to begin with.”); see also SiteSafe Comments at 4 (finds Category One sign confusing).

²⁴⁵ An example would be a rooftop hatch.

²⁴⁶ See IEEE Std C95.7-2005, Section 4.5.1.

or indicators in place of signs, presuming that those authorized persons are trained to recognize and understand the actions necessary to control their exposure where the controls or indicators are placed at the occupational limit boundary. A sign affixed to an antenna will be considered sufficient only if it specifies a minimum approach distance and is readable from the direction of approach and at least at the separation distance required for compliance with the occupational exposure limit in Section 1.1310. Additionally, appropriate training is required for any occupational personnel with access to the controlled area where the general population exposure limit is exceeded, and transient individuals must be supervised by trained occupational personnel upon entering any of these areas. Use of time averaging is required for transient individuals to ensure compliance with the general population exposure limit. Though not required, use of personal RF monitors in the areas where the general population exposure limit is exceeded is an option to ensure compliance. Similarly, use of personal protective gear (such as properly-worn RF protective suits) is another option to ensure compliance for occupational individuals in the areas in which the occupational exposure limit is exceeded but is not a requirement for all situations. If such mitigation procedures or power reduction, and therefore Category reduction, are not feasible, then lockout/tagout procedures in 29 CFR § 1910.147 must be followed.

96. Category Four applies to locations where the exposure limit for occupational personnel would be exceeded by more than a factor of ten or where there is a possibility for serious contact injury. Where the occupational limit could be exceeded by more than a factor of ten, “WARNING” signs in orange color are required, and “DANGER” signs in red color are required where immediate and serious injury will occur on contact, in addition to positive access control.²⁴⁷ For example, “DANGER” signs are required at the base of AM broadcast towers where serious injuries due to contact burns may occur. If power reduction would not sufficiently protect against the relevant exposure limit in the event of human presence considering the optional additional use of personal protective equipment, lockout/tagout procedures must be followed to ensure human safety.²⁴⁸ Category Four signs indicate the most hazardous locations, and alert people to protect against potentially serious and immediate harm, even though Category Three signs already indicate an area surpassing the occupational exposure limit for continuous exposure. The only apparently adequate mitigation measure within the Category Four area is power reduction²⁴⁹ that will bring exposure within the occupational limits.²⁵⁰ The fact that the location of potential overexposure is temporary—like a scaffolding—does not relieve any of the licensees or operators of the obligation to warn or accommodate the workers that may be in the area of overexposure.²⁵¹

²⁴⁷ IEEE Std C95.7-2005 provides examples of the proper use of “DANGER” signs “as in the case of RF burns and/or RF electrical shocks.”

²⁴⁸ According to the National Association of Broadcasters Engineering Handbook, 10th Edition, OSHA’s “lockout/tagout” requirement (OSHA Regulations, 29 CFR § 1910.147) would require the appropriate transmitter to be shut down during the presence of occupational personnel. To prevent unexpected activation of the transmitter, “the circuit breaker feeding the transmitter should be locked (using a padlock) into the off position, and a warning tag placed to indicate that the transmitter may not be operated until the lock and tag are removed by the person who installed them.”

²⁴⁹ As recognized by Tell, turning off power completely (“lockout/tagout”) is an alternative. See Tell Comments at 14.

²⁵⁰ As for Tell’s request for content requirements of an environmental assessment, we note that those are already outlined in 47 CFR § 1.1311. See *Human Exposure to Radiofrequency Electromagnetic Fields*, DA 15-683, Small Entity Compliance Guide, released June 10, 2015. We further note that no applicant has ever exercised the option to submit an Environmental Assessment rather than take the steps needed to mitigate exposure so as to stay within the limits.

²⁵¹ We recognize the difficulty of this situation, and guidelines for reasonable efforts compliance will be provided in the Bulletin 65 to be published by OET.

97. H&E urges the Commission to remove the Category Four (10X occupational) requirement, because it does not correspond to an exposure limit.²⁵² We disagree. While ten times the limit is not explicitly listed in section 1.1310 of our rules, it forms the underlying basis of human protection and is inherently associated with our exposure limits because of the multiplicative margins incorporated into these limits when they were derived. This factor of ten times the occupational limit is thermally based on a whole-body SAR threshold of 4 W/kg and is intended to protect against behavioral disruption. Independent of these thermal protections, Category Four additionally seeks to protect against the possibility for serious injury (such as shocks or burns) from direct contact with objects having high potential, which on its own necessitates action to protect workers accessing such areas. Moreover, Category Four necessarily requires actions above and beyond what would be required under Category Three, by prohibiting access to such areas without reduction in power to a lesser Category (e.g., Category One, Two, or Three). Keeping this additional action level in place serves as a reminder to trained occupational personnel about the severity of consequences in entering such an area without undertaking additional proactive preventative measures.

98. OSHA has expressed general concern about workers who might be unaware of their potential for overexposure on a building;²⁵³ for example, the exposure level at one side of a door leading to a rooftop might be significantly below the public limit, but the limit might be exceeded soon after entering the rooftop area.²⁵⁴ If awareness and control of exposure by trained rooftop and other workers can be achieved with appropriate postings and markings of regions where the general population/uncontrolled limits are exceeded, then these workers may be exposed up to the occupational/controlled limits without site-specific training or supervision. Untrained workers should not have access to controlled locations without supervision. This concept would apply equally to any conventional or rooftop transmitter site as it would to a concealed or camouflaged antenna site, such as those found installed in church steeples, behind false walls or building facades, within faux vegetation, inside of storefront signs, lampposts, kiosks, *etc.*²⁵⁵ For the trained worker, in addition to standard signs, boundaries may be shown on diagrams at the access point and by rooftop paint markings in the Category Two and Three regions, and signs and/or barriers at the boundary of the Category Three region should ensure awareness and prevent exposure above the occupational/controlled limits. Where there are only Category Two regions, in addition to standard signs, a diagram at the access point and paint markings in the Category Two area would be sufficient, where positive access controls are in place to effectively restrict access only to authorized persons in areas where the public limits are exceeded. Where the general public (including untrained workers) may have access to such areas, however, they cannot be

²⁵² See H&E Reply at 3-4.

²⁵³ OSHA Comments at 3 (discussing concerns over the extent to which workers receive RF awareness training and the readability of signs outside of the compliance boundary, and encouraging the Commission to develop guidance on appropriate procedures for workers accessing multi-use buildings and rooftops).

²⁵⁴ See SiteSafe Comments at 4.

²⁵⁵ We recognize that each transmitter site is unique, and many antennas are designed and installed to meet aesthetic goals and/or local zoning and building requirements. The intent of our signage requirements is to establish awareness for persons accessing areas near those antennas where our RF exposure limits are exceeded. The proper placement of such signs need not be obtrusive or counter to design goals. Where antennas are placed inside of structures or behind facades, a sign need be placed outside of that structure only if there is an area outside of that structure or facade where the limits are exceeded in a location that the general population could reasonably be anticipated to access. That sign need be of a size and placement only sufficient for legibility at the boundary of such area. Seldom will such a sign pose an aesthetic concern from the further distances and vantages of the general public. Where a concern remains, the antenna can be set further back from the outside of the façade to shrink or eliminate the exposure area and the corresponding size of the sign and its orientation. Where an antenna is atop a steeple, for example, it is unlikely there will be an area of human potential presence nearby, except at a high elevation from the ground and signage at such a location (e.g., the side of a building facing a steeple-mounted antenna) similarly should not pose an aesthetic concern.

expected to understand the meanings of markings and signage, and barriers at all boundaries marked at regular intervals are required to ensure compliance.

99. Several commenters claim that the signage requirements are burdensome.²⁵⁶ Verizon and AT&T urge the Commission to require only a sign associated with the highest category at the site.²⁵⁷ We agree that placement of multiple signs contribute to the problem of oversignage, and hence, we provide that if the boundaries between Category Two and Three are such that placement of both Category Two and Three signs would be in the same location, then the Category Two sign is optional.²⁵⁸ Similarly, only a Category Four sign is necessary where Category Three and Category Four apply to the same location. Further, parties are not required to place multiple signs in places where exposure boundaries are close together.

100. Other commenters question our proposed rules regarding sign content and readability.²⁵⁹ The International Brotherhood of Electrical Workers (IBEW) claims that existing signs are often ambiguous and placed as a general warning, fail to protect IBEW members, and should not be considered a catchall for RF compliance.²⁶⁰ However, the four categories of signage specify consistent and widely recognized symbols, colors, and vocabulary to reliably convey the meaning of the signs. Our new rules seek to cover all possible exposure situations and to do so in a manner clearly appropriate to each situation, especially as technologies are quickly evolving, and these requirements may become relevant in the future. Further, a trained worker will be able to interpret the signs to appropriately control his/her exposure.

101. OSHA and Narda point out that the label or small sign permitted in controlled environments might not be readable from a safe distance, and suggest ways to ensure that signs can be read by the time that a worker encounters the exposure limit boundary.²⁶¹ Our new rules include the requirement that signs be legible *and* readily viewable and readable at a minimum distance of five feet (1.52 m) from the boundary (and as necessary on approach to this boundary) at which the applicable limits are exceeded, and that controls or indicators be placed *at* compliance boundaries. As to what would satisfy our requirement to be “readable,” we invoke OSHA rules regarding specifications for accident prevention signage.²⁶² Since OSHA’s rules require readability at a minimum distance of five feet

²⁵⁶ See Verizon Comments at 14-15; *see also* WIA Comments at 8-9 (opposing any requirement to place multiple category signs at a transmitter site or where each tier is exceeded); *see also* H&E Reply at 3-4 (arguing a signage requirement with up to four categories would be burdensome and could result in over-signage and confusion); WIA Reply at 4; UTC Reply at 8.

²⁵⁷ See Verizon Comments at 14-15 (arguing the rules should be specific about where signs must be located (access points and antennas) and what they should say); *see* AT&T Reply at 9 (arguing that Category Two NOTICE signs will be confusing, conflicting, impractical, and cause undue administrative burdens at sites where Category Three CAUTION signs are already required).

²⁵⁸ See *infra* Appx. A, Amended Rules 47 CFR § 1.1307(b)(4)(iii).

²⁵⁹ See Tell Comments at 13-14 (questioning the terminology and consistency of the proposed rules in dealing with access, control, and time-averaging and requests several clarifications); SiteSafe Comments at 4 (suggesting that signs must provide clear and specific instructions to transient individuals about how to mitigate exposure, which is not the case for current signs in common use, and requests that an update to OET Bulletin 65 include example language for signs as needed for transient individuals).

²⁶⁰ See IBEW Comments at 2. IBEW also points to non-rooftop issues and questions whether signs can be effective at antennas attached to poles, on the sides of buildings or water tanks, and stealth antennas.

²⁶¹ See OSHA Letter at 3; Narda Comments at 3.

²⁶² 29 CFR § 1910.145, Occupational Safety and Health Standards, Specifications for accident prevention signs and tags: “The signal word shall be readable at a minimum distance of five feet (1.52 m) or such greater distance as warranted by the hazard”; Howett, G.L., Size of Letters Required for Visibility as a Function of Viewing Distance and Observer Acuity, National Bureau of Standards, Washington DC, July 1983.

(1.52 m) “or such greater distance as warranted by the hazard,” we expect that requiring signs to be legible, readily viewable, and readable as necessary on approach will satisfy OSHA’s concern. As also suggested by OSHA and SiteSafe in their comments, we will be developing additional guidance in a future revision of our supplementary material, including OET Bulletin 65, for compliance at multi-use sites.

102. To avoid oversignage and confusing signage, accurate placement of appropriate signage is critical and should make clear both where limits are exceeded and where limits are not exceeded. A number of commenters had specific suggestions on the placement of the signs. The EMF Safety Network suggests mandating setbacks of 1,500 feet from cell towers for signs.²⁶³ SiteSafe suggests signs be placed at the boundary of OSHA-required fall protection areas where exposure levels exceed our limits, indicating antenna locations and areas where exposure limits are exceeded because these areas may be accessed by workers using lifting or climbing devices.²⁶⁴ We find the suggested setback as unnecessary, impractical and inconsistent with our policies that distance to compliance boundaries be based on the effective radiated power and other variables related to the installation of transmitters at a site rather than a set distance. At the same time, we agree with SiteSafe that effective placement of signs is necessary to inform workers prior to accessing these areas. Parties interested in recommendations for sign layout, color, symbology, *etc.*, may refer to the detailed description in IEEE Std C95.2-1999, as well as the subsequent guidance materials we will offer on categories and signs in a future revised version of OET Bulletin 65. Further, while we also agree that a site safety plan may be an effective part of an acceptable routine evaluation, we do not adopt such a measure as a required component.²⁶⁵ Because each site is different, our rules are flexible about how to prevent access to spatial regions where the RF exposure limits are exceeded and what mitigation measures are adequate for each specific circumstance. Additional guidance on best practices for site safety plans may be released in future revisions of our supplementary materials, including OET Bulletin 65.

103. As suggested by CSCP, we will require signs to provide an up-to-date point of contact, but we decline RF Check’s suggestion of explicitly requiring 24/7 monitoring.²⁶⁶ We have no evidence that continuous round-the-clock monitoring is necessary or practical, , we anticipate that licensees with many installations in diverse locations would provide a contact that can respond expeditiously much as they do for maintenance issues that may arise in their networks. In many cases where the exposure is sufficiently limited such that remains below Category Three, there should be no need to contact a licensee because power reduction would be unnecessary for compliance with the occupational limits, as long as workers are effectively made aware of their exposure and are able to exercise control over their exposure. We will monitor complaints about unavailability of contact points as they may arise and work with parties as appropriate. We will not specify a response time, as was suggested by Wessel, because normal good

²⁶³ See EMF Safety Network Comments at 10. EMF Safety Network suggests that transmitters be turned off when workers are present. The Commission supports lockout/tagout procedures to turn off transmitters where necessary to maintain a safe working environment. See *infra* Appx. A, Amended Rules 47 CFR § 1.1307(b)(4)(iv)-(v).

²⁶⁴ SiteSafe Comments at 2-4 (Fall protection areas are required of employers so as to prevent employees from falling off of overhead platforms, elevated work stations or into holes in the floor and walls. See <https://www.osha.gov/SLTC/fallprotection/>.) In addition to signage, SiteSafe recommends that a safety plan be part of a routine evaluation and should be shared with licensees, site management, and personnel working at a site. For small indoor antennas, SiteSafe suggests that placement of signs at the antennas for Wi-Fi or other internet access points would not be practical and notes that some jurisdictions require stealth screening of outdoor antennas, which complicates sign placement for those antennas.

²⁶⁵ SiteSafe Comments at 4.

²⁶⁶ See CSCP Comments at 3 (supporting requirement for contact information on signs and emphasizes that the contact information be up-to-date, so that the public can readily obtain exposure information about sites where they have concerns); see also RF Check *Ex Parte* at 11 (“Safety Center Specialists are accessible 24/7 via Internet or phone.”).

business practice should dictate prompt response, and the requirement for identification of the monitored contact point should be effective.²⁶⁷ We encourage parties responsible for such contact points to promptly respond to complaints and find appropriate solutions.

3. Training to Ensure Compliance

104. RF safety awareness training is critically important to ensure that exposed persons are fully aware of the potential for exposure and can exercise control over their exposure, as required in environments qualifying to apply occupational/controlled limits.²⁶⁸ Adequate training should provide trainees with a complete understanding of the actions necessary to ensure their compliance with the exposure limits in various circumstances. In the *2013 RF Further Notice*,²⁶⁹ in determining what would constitute “appropriate training,” we proposed to consider the topics outlined in Annex A of IEEE Std C95.7-2005 as guidance to be referenced in a future revision of OET Bulletin 65, and to allow for web-based training or similar programs.²⁷⁰

105. The record includes numerous requests for clarification regarding what constitutes adequate training under our rules. UTC requests that the Commission clarify mitigation requirements regarding “training and notification” and provide flexibility.²⁷¹ WIA suggests centralized training, either administered by the Commission in coordination with the Occupational Safety and Health Administration (OSHA) or through an association or trade group.²⁷² Tell requests a detailed definition of training, suggesting that limited but specific instruction on behavior near active antennas is all that is necessary in most cases.²⁷³ Similarly, Wessel suggests that training for occupational/controlled exposure needs a clear and detailed definition and that while it is possible for information conveyed by signs to be sufficient the signs might not remain in place.²⁷⁴ H&E suggests that training be consistent with Annex A of IEEE C95.7-2005, and subsequently IEEE C95.7-2014, but that some of the material be simplified for building maintenance personnel.²⁷⁵ H&E also recommends substantive testing and renewal requirements for training.²⁷⁶

106. The level of detail provided in the training section of IEEE C95.7-2014 demonstrates the difficulty in prescribing clear and simple criteria for what constitutes appropriate training. Accordingly, we direct OET to consider the topics outlined in Annex A of IEEE C95.7-2005 as training guidance to be referenced in a future revision of OET Bulletin 65 as promptly as practicable and with an eye towards providing appropriate language for those who will rely on it, and to continue to revise this guideline as experience dictates. For this, OET will coordinate with OSHA, as recommended by WIA, to ensure that the revision of Bulletin 65 will provide sufficient guidance to people who work in the presence of RF transmitters. In the case of training using oral information, we clarify that either spoken word or pre-recorded audio from an authorized individual qualified to provide such instructions on how to remain

²⁶⁷ See Wessel Comments at 3 (stressing the importance of a timely response when using contact information on signs as maintenance on rooftops is often a matter of some urgency).

²⁶⁸ See *2013 RF Order and Notice*, 28 FCC Rcd at 3523, para. 75; see also, IEEE C95.7-2005; IEEE C95.7-2014.

²⁶⁹ *2013 RF Order and Notice*, 28 FCC Rcd at 3565, para. 195.

²⁷⁰ See *id.*

²⁷¹ See UTC Reply at 1, 7-8.

²⁷² See WIA Comments at 9.

²⁷³ See Tell Comments at 2.

²⁷⁴ See Wessel Comments at 3.

²⁷⁵ See also Motorola Comments at 8-9 (supporting the use of IEEE-C95.7-2005); see also IEEE-ICES Comments at 2.

²⁷⁶ See H&E Reply at 4.

compliant is acceptable.²⁷⁷ Training may also include web-based programs.²⁷⁸ We also make clear that instant “training” via signage at an access door is insufficient to achieve the goal of compliance for those persons potentially exposed beyond that door, even assuming that diagrams of a rooftop are read and understood.

4. Responsibility for Mitigation Measures

107. Numerous comments requested limitations on a licensee’s responsibility for mitigation measures.²⁷⁹ Verizon, WIA, and others argued for a “safe harbor” from actions and events beyond their control at the restricted area when the area is not controlled by the licensee.²⁸⁰ Verizon contends that there is no practical action it can take to ensure continuously that certain sites are compliant.²⁸¹ According to Verizon, if a rooftop door is left unlocked by a third party despite Verizon’s best efforts to control exposure (including posting appropriate signs and implementing access controls), it should not be considered to have violated the Commission’s rules.²⁸² Verizon suggests that safe harbor requirements include the following elements: category-appropriate signage, access controls, indicative or physical barricades, RF safety training, information about RF exposure risks in accessible areas, and 24/7 contact information.²⁸³ Similarly, WIA urges that mitigation measures should include only those steps that the licensees can reasonably control and that the licensee should not be held liable when, despite its best efforts, a third party does not comply with mitigation requirements.²⁸⁴ WIA points out that rooftop access is typically managed by the building’s owner, whose duty should be to work with licensees to mitigate exposure.²⁸⁵ WIA also suggests that RF mitigation rules should not conflict with federal, state, or local laws or safety codes.²⁸⁶ Boston and Philadelphia opposed any safe harbor, on the grounds that a safe harbor would excuse noncompliance and, instead, suggested that the Commission should look at the facts in any given case to determine responsibility.²⁸⁷ IBEW also opposes a safe harbor approach, noting in

²⁷⁷ See AT&T Comments to *Notice* at 1.

²⁷⁸ SiteSafe Comments at 5 (supporting our training requirement of written or oral instruction, or both, and suggesting that training could be accomplished by “class room, computer based, and on-the-job training from a competent instructor.”).

²⁷⁹ The Commission clarified the responsibilities of licensees at multi-use transmitter sites, and sought comment on the extent and limitation of these responsibilities, as well as how to encourage better cooperation between property owners, managers, and licensees, in response to commenters that suggested that our rules do not address the apportionment of responsibility among licensees in all situations. *2013 RF Order and Notice*, 28 FCC Rcd at 3525-26, 3564, paras. 80-84, 193.

²⁸⁰ See WIA Comments at 2-3, 5-8; Verizon Comments at 2, 10-13; AT&T Reply at 3-4, 8-9; AICC Reply at 20; WIA Reply at 1, 4-5; Verizon Reply at 4; Verizon Ex Parte at 2 (February 10, 2014); Verizon Ex Parte at 2 (May 6, 2015); Verizon Ex Parte at 1 (January 13, 2016); Verizon Ex Parte at 1 (June 15, 2018). *But see* Boston & Philadelphia Reply at 6; Gil Amelio Letter at 1; IBEW Comment at 1-2; AFGE/AFL-CIO Comment at 1; RF Check Ex Parte at 1 (March 4, 2014); RF Check Ex Parte at 1, 19 (October 8, 2014); RF Check Ex Parte at 20 (December 18, 2015); National Antenna and Tower Safety Center Ex Parte at 14.

²⁸¹ See Verizon Comments at 2, 10-13; Verizon Reply at 4; Verizon Ex Parte at 2 (February 10, 2014); Verizon Ex Parte at 2 (May 6, 2015); Verizon Ex Parte at 1 (January 13, 2016); Verizon Ex Parte at 1 (June 15, 2018).

²⁸² See Verizon Comments at 12; Verizon Ex Parte at 2 (February 10, 2014); Verizon Ex Parte at 1 (May 6, 2015); Verizon Ex Parte at 1 (January 13, 2016).

²⁸³ See Verizon Comments at 12.

²⁸⁴ See WIA Comments at 2-3, 5-8; WIA Reply at 1, 4-5.

²⁸⁵ See WIA Comments at 7.

²⁸⁶ See WIA Comments at 6.

²⁸⁷ See Boston & Philadelphia Reply at 6.

particular that signs by themselves should not be considered sufficient to establish compliance.²⁸⁸ UTC and AICC propose that new entrants should be responsible for mitigation at such sites.²⁸⁹

108. RF Check suggests that the Commission recognize that licensees alone cannot ensure compliance and that a comprehensive, uniform solution that involves all parties is necessary.²⁹⁰ RF Check proposes the creation of a database in which transmitting antennas are registered and their exposure areas calculated, with the antenna and exposure areas visually depicted.²⁹¹ This database would be accessed and viewed by a worker at any worksite via smartphone.²⁹² WIA supports a private sector neutral third-party collecting and distributing RF safety information as consistent with its recommendation that the Commission facilitate centralized training.²⁹³ We decline to mandate the registration of each transmitting antenna in a database. Such proposal is overbroad and burdensome. With the implementation of 5G technologies such requirement will impose costs to licensees and operators while its benefit is not necessarily evident. Carriers are densifying their networks with an increasing speed, and though at times they might place antennas in non-visible locations, most of them can be seen and recognized. Further, the RF characteristics of such antennas vary, impacting the degree of RF exposure.

109. Such a comprehensive catalogue of sites and “safety” zones would further impose a burden on all site owners, regardless of whether they are able to achieve effective compliance without such participation. Moreover, mandating such participation would effectively delegate our responsibility to an organization over which we have no oversight or control.²⁹⁴ Additionally, in the absence of full data on all RF sources, reliance on such a system could expose unwitting users who rely exclusively on that system to RF exposure in excess of our limits from sources not accounted for in that system. Accordingly, we do not adopt a safe harbor for site compliance. If any licensee chooses to outsource its compliance function to a third party, it can do so, but the licensee would remain wholly liable for compliance.

110. Regarding the effectiveness of mitigation measures at transmitter sites to ensure compliance,²⁹⁵ Narda argues that a locked rooftop with posted signs is not effective and that barriers are needed because third-party workers who are given access may not be able to identify an antenna so as to stay a certain distance away from it.²⁹⁶ EMRPI also states that wireless sites with concealed or camouflaged antennas are common, so workers with access to them have no knowledge of their exposure and no recognition that a site could be hazardous.²⁹⁷ We agree, and the rules we adopt reflect that signs alone do not comprise an RF safety program; however, the composition of a barrier within a controlled area might be either a restrictive, physical barrier, or an indicative barrier depending on the unique

²⁸⁸ See IBEW Comment at 1-2.

²⁸⁹ See UTC Reply at 1; AICC Reply at iii.

²⁹⁰ See RF Check Comments at 3-4, 8.

²⁹¹ *Id.*

²⁹² *Id.*

²⁹³ See WIA Reply at 5.

²⁹⁴ See *U.S. Telecom Ass’n v. FCC*, 359 F.3d 554, 565-69 (D.C. Cir. 2004).

²⁹⁵ See *2013 RF Order and Further Notice*, 28 FCC Rcd at 3530, para. 100 & n.172.

²⁹⁶ See EMRPI Comments at 10; Narda Comments, ET Docket No.13-84, at 1; *see also* Wessel Comments at 2 (contends that few licensees with fixed rooftop transmitters have appropriate signs, associated training, or procedures to identify exposure categories, and that access is often granted to individuals without knowledge or ability to control exposure, so that restriction on access does not result in a “controlled environment” as defined in IEEE Std C95.7-2005/C95.7-2014).

²⁹⁷ See EMRPI Reply at 4.

circumstances of the site, so workers, who are required to be trained, may readily recognize the antennas in the controlled area.

111. IBEW states that ensuring compliance with the exposure limits by the licensee is not effective and cannot or is not being enforced. While IBEW believes that the licensee's responsibility is a non-delegable duty, it suggests that practical RF safety should be a shared responsibility maintained among regulators, licensees, property owners and managers, employers, employees, and subcontractors.²⁹⁸ It indicates it is assessing the potential overexposure of its members, and recommends that all parties work with RF Check to ensure compliance with the Commission's exposure limits.²⁹⁹ RF Check suggests that the Commission make explicit that a licensee's compliance with Commission rules does not relieve an employer of its duties under OSHA regulations.³⁰⁰

112. These claims of the alleged prevalence of noncompliance at rooftop sites, although unsupported by empirical evidence, seem to be animating, in part, the calls for a safe harbor on the part of the wireless carriers who fear Commission enforcement action for sites they do not control. Dependence on property owners who may find those controls to be a nuisance or even in conflict with other safety goals (*e.g.*, locked egress doors) or legal requirements (*e.g.*, set-backs) is problematic. We find that a licensee's due diligence in ensuring compliance with the RF exposure requirements is the appropriate test for a safe harbor. As discussed by Verizon, we anticipate that due diligence would include elements such as category-appropriate signage, access controls, indicative or physical barricades, RF safety training, information about RF exposure risks in accessible areas, and 24/7 contact information. We recognize that the specific elements that are appropriate for any given installation may differ, such as situations where local safety codes require access to the roof at all times in case of emergencies. Therefore, we would consider the totality of the measures that were taken in any given instance. The greater specificity we provide regarding effective mitigation measures should go a long way to reducing the concerns of licensees³⁰¹. We appreciate that operators should not be held responsible for things beyond their control. With regard to the various parties raising concerns about a safe harbor, we note that we have taken numerous steps in this proceeding to clarify a licensee's obligations and these requirements are

²⁹⁸ See IBEW Comments at 3.

²⁹⁹ See *id.*

³⁰⁰ See RF Check Comments at 7.

³⁰¹ See, *e.g.*, Verizon Ex Parte at 1 (May 6, 2015), in requesting that the Commission adopt a safe harbor "with respect to carrier efforts to restrict access to radio frequency transmitters located at rooftop locations, ... Verizon is committed to operating and does in fact operate safe and effective transmitters, but the actions of third parties that carriers cannot control may limit in some cases what carriers can do to prevent unauthorized access to transmitter sites."; Boston & Philadelphia Reply at 6: "[Commission adoption of 'safe harbors'] would seem to invite any number of easy excuses for RF radiation risks to untrained or unaware persons. The better solution, we believe, is give providers every incentive to inform third parties of these risks and enlist their help in protection. In the end, not all over-exposure can be prevented, but the facts of any given case should determine whether the provider or the interloper or some third party is to blame"; Gil Amelio Letter at 1: "It appears that some carriers are continuing to ask the FCC to grant them a safe harbor for merely maintaining the antiquated system of signs and fences that fails to protect workers in today's wireless environment."; IBEW Comment at 1: "Granting the discussed 'safe harbors' and reducing the frequency of inspections would only aggravate the already hazardous situation facing our members, making it even more difficult for them to assess situations and take the safety precautions needed to protect themselves from unnecessary risk."; AFGE/AFL-CIO Comment at 1: "This is not the first time carriers have requested a safe harbor. It appears their concern has more to do with protecting their financial interests rather than RF safety. Displaying a lack of willingness to address RF radiation exposure will only result in workers continuing to be exposed needlessly."

enforceable. Moreover, responsibility for maintenance of the conditions that permit a siting within our rules can be an enforceable condition of any such lease.³⁰²

113. In reference to UTC's and AICC's comments on the responsibilities and potential liabilities of new entrants at multiple transmitter sites, we recognize that an entity responsible for new construction or modification of existing facilities could bring a compliant site out of compliance. First, we reiterate that all licensees subject to Section 1.1307(b) of our rules continue to share responsibility for maintaining compliance and the obligation to bring a previously-compliant site back into compliance, as may be necessary. This requirement, along with the requirement for new and renewal applicants to evaluate and ensure compliance at sites, is an important mechanism to maintain ongoing compliance.³⁰³ It is critical that all occupants of a site share responsibility to ensure that compliance at a site is maintained. Second, if an environmental change or other external factor or event occurs that brings a site out of compliance, all licensees share the responsibility for any modification or remediation necessary to bring the site into compliance. Finally, if a site is found out of compliance, a licensee that can demonstrate that its facility was compliant and did not cause the non-compliance will not be liable in an enforcement proceeding relating to the period of non-compliance. This approach allows the consideration of evidence on a case-by-case basis during any appropriate enforcement action and addresses the commenters concern to avoid inappropriately assigning liability to innocent parties where the source of noncompliance can be identified.

114. We reject Portland's argument that, in addition to the Commission's requirements concerning warning signs and barriers, local authorities should be allowed to require additional signs and access restriction where they deem them appropriate.³⁰⁴ While Section 332(c)(7)(B)(iv) of the Act permits state and local governments, when making decisions on the "placement, construction, and modification" of personal wireless service facilities, to consider whether such facilities comply with the Commission's regulations concerning RF emissions, it expressly prohibits them from imposing their own regulations on such facilities on the basis of the environmental effects of such emissions.³⁰⁵ Thus, "[p]ursuant to Section 332(c)(7), and consistent with the Commission's general authority to regulate the operation of radio facilities, State and local governments are broadly preempted from regulating the

³⁰² Wessel contends that there is a lack of cooperation among property owners, managers, licensees, and subcontractors amounting to a "systemic failure" in the industry and suggests that since property owners and managers have been held accountable by the Commission's Enforcement Bureau for interference caused by equipment on their property the same could be done for violation of RF exposure limits on the property. *See* Wessel Comments at 2. (We observe that each of these occasions was related to violations in the use of unlicensed devices, which are enforceable under our rules on the users of the device.) Wessel also references an insurance industry article dealing with property manager and owner risks associated with RF exposure. *See* Wessel Comments at 3. (While this point may illustrate the potential seriousness of violation, it is not obviously relevant to placing compliance responsibility, and it is not discussed in our resolution.)

³⁰³ *See 2013 RF Order and Notice*, 28 FCC Rcd at 3526, para. 84:

We note that when routine evaluations are required at such sites, all relevant co-located licensees are responsible for compliance. Therefore, it is in the interest of these licensees to share information about power and other operating characteristics in order to achieve accurate representations of the RF environment. The Commission continues to encourage all site occupants, owners, leasers, and managers to cooperate in these endeavors, and we note that site user agreements are particularly useful and desirable to achieve this end. As demonstrated in the record, all licensees that exceed five percent of the RF exposure limit at any non-compliant location are jointly and severally responsible, and the Commission may impose forfeiture liability on all such licensees.

³⁰⁴ City of Portland Comments at 4.

³⁰⁵ 47 U.S.C. § 332(c)(7)(B)(iv).

operation of personal wireless service facilities based on RF emission considerations.”³⁰⁶ The Commission’s rules echo this statutory provision.³⁰⁷ Many courts have confirmed that state or local regulation of RF emission safeguards would “disrupt the expert balancing underlying the federal scheme” in the context of proceedings such as this one, where the Commission has “weighed the competing interests relevant to the particular requirement in question, reached an unambiguous conclusion about how those competing considerations should be resolved, and implemented that conclusion via a specific mandate.”³⁰⁸ Indeed, as noted above,³⁰⁹ state-level warning regimes risk contributing to an erroneous public perception or otherwise disrupt the federal regime.

D. Transition Periods

115. As an initial matter, we emphasize that compliance with the RF exposure limits is an existing requirement that applies to all licensees, as well as grantees of portable, mobile, and unlicensed device equipment authorizations, irrespective of whether they were exempt from evaluation under the old rules. Licensees are always responsible for the compliance of their sites and their equipment in protecting persons from RF exposure in excess of our limits. Still, our new rules will provide greater clarity and certainty to licensees, equipment manufacturers, and the public.

116. Even though we anticipate that comparatively few facilities will require evaluation under the new rules, and such evaluations will be relatively straightforward, in order to ameliorate any hardship caused by the change to the new exemption and evaluation framework, we set a timetable for conducting the reevaluation, under the new rules, of antenna locations that were previously exempt from evaluation under the existing rules. We will allow two years from the effective date of the new rules for licensees to determine if evaluations are required, to perform them where necessary, and to comply with the more specific mitigation requirements we adopt in this order as may be necessary.³¹⁰ This transition period comports with the essentially unanimous view of commenters in their consideration of the scope and logistics involved,³¹¹ and in our experience should be adequate for those with the largest number of sites to evaluate or to reevaluate.³¹² This two-year transition period will allow not only licensees and manufacturers to complete the evaluations or determine whether they are exempt from evaluation, but will also allow an orderly transition for the licensing Bureaus and the FCC equipment authorization program to incorporate the new exemption criteria into their station authorization and certification policies and procedures.

³⁰⁶ *Procedures for Reviewing Requests for Relief from State and Local Regulations Pursuant to Section 332(c)(7)(B)(v) of the Communications Act of 1934*, 15 FCC Rcd 22821, 22828, para. 17 (2000) (citing *Cellular Phone Task Force v. FCC*, 205 F.3d 82, 95-96 (2d Cir. 2000)); see also *New York SMSA Ltd. P’ship v. Town of Clarkstown*, 612 F.3d 97, 105 (2d Cir. 2010) (the Act “occupies the field” of “regulation of the technical and operational aspects of wireless telecommunications service,” to the exclusion of state or local regulation).

³⁰⁷ 47 CFR § 1.1307(e).

³⁰⁸ *Farina v. Nokia, Inc.*, 625 F.3d 97, 123, 126 (3d Cir. 2010) (quoting *Medtronic, Inc. v. Lohr*, 518 U.S. 470, 501 (1996), and citing *Buckman Co. v. Plaintiffs’ Legal Committee*, 531 U.S. 341, 348 (2001)); accord *Robbins v. New Cingular Wireless PCS, LLC*, 854 F.3d 315, 319-20 (6th Cir. 2017) (“By delegating the task of setting RF-emissions levels to the FCC, Congress authorized the federal government—and not local governments—to strike the proper balance between protecting the public from RF-emissions exposure and promoting a robust telecommunications infrastructure.”).

³⁰⁹ See para. 16 *supra*.

³¹⁰ See AT&T Reply at 11.

³¹¹ H&E Reply at 4; Verizon Comments at 15; WIA Comments at 5; SiteSafe Comments at 5.

³¹² We note that this is six months longer than the period that was recently agreed to with one of the major cellular telephone service providers. See *Cellco Partnership*, Order, 29 FCC Rcd 4789, 4794 (EB 2014).

117. We reiterate and emphasize that all licensees and grantees are responsible for compliance of their facilities and equipment with our RF exposure rules irrespective of their exemption status. Even though licensees are provided with adequate time to reevaluate locations, they still bear the responsibility of protecting persons from RF exposure in excess of our limits. As such, while lack of utilization of the signage and other guidance provided in this *Order* will not constitute a *per se* violation of mitigation requirements during the transition period, all responsible parties are liable at all times for providing appropriate protection from RF exposure above our limits, and thus should be motivated to adopt the measures that best ensure our agreement with their compliance—those measures adopted herein—as soon as possible.

E. Conforming Edits

118. In the *2013 RF Further Notice* we proposed to reword some of our rules in sections S 1.1307(b), 1.1310, 2.1091, and 2.1093 as necessary to ensure clarity and consistency.³¹³ In addition, we proposed to make changes to specific sections of Parts 15, 24, 25, 95, and 97 for consistency and as necessary depending on the substantive changes in Parts 1 and 2.³¹⁴ Because the Commission proposed that our general exemption criteria apply to all rule parts authorizing RF sources, specific exceptions provision in rule parts other than in Parts 1 and 2 are not necessary. Nonetheless, where various existing rule parts include paragraphs or sections concerning RF exposure requirements, we are updating those for consistency. No specific comments were received on these proposals and we adopt each of them for the reasons set forth in the *Further Notice*. Accordingly,

- For applicants for equipment authorizations covered by Parts 15 and 18, in Sections 15.212(a)(viii), 15.247(i), 15.255(g), 15.257(g), 15.319(i), 15.407(f), 15.709(h), and 18.313, we substitute our general exemption criteria for the specific exemption from routine evaluation;
- For applicants and licensees in the Public Mobile Service Personal Communications Service, we add and substitute our general exemption criteria for the specific exemption from routine evaluation in Sections 22.379 and 24.52;
- For applicants and licensees of satellite earth stations, we remove the 5 percent criterion in Section 25.117(g) and introduce similar language to Section 25.115, paragraph (p), Section 25.129, paragraph (c), Section 25.149, paragraph (c)(3), and Section 25.271, paragraph (g);
- For applicants and licensees in the Miscellaneous Wireless Communications Services, Radio Broadcast Services, and Private Land Mobile Services we substitute our general exemption criteria for the specific exemption from routine evaluation by modifying Section 27.52, Section 73.404, paragraph (e)(10), and by adding Section 90.223 and removing Section 90.223;
- We add mobile devices to Section 95.2385 for WMTS and edit Section 95.2585 to eliminate the limited specification of FDTD modeling for MedRadio service medical implants;
- For applicants and licensees in the Amateur Radio Service, we substitute our general exemption criteria for the specific exemption from routine evaluation based on power alone in Section 97.13(c)(1) and specify the use of occupational/controlled limits for amateurs where appropriate; and
- For applicants and licensees in the Multichannel Video Distribution and Data Service, we

³¹³ *2013 RF Order and Notice*, 28 FCC Rcd at 3569, para. 204.

³¹⁴ *Id.*

substitute our general exemption criteria for the specific exemption from routine evaluation of stations in the 12.2-12.7 GHz frequency band with output powers less than 1640 watts EIRP, in Section 101.1425.

Each of these changes will improve consistency and clarity of the rules.

V. NOTICE OF PROPOSED RULEMAKING

119. This *Notice of Proposed Rulemaking (NPRM)* seeks to develop a record that will enable us to address the challenges presented by evolving technological advances. Devices are operating in new frequency bands, changing the way we use wireless devices, the way the supporting wireless infrastructure is deployed, and the way RF sources in general are assessed for compliance. One example is technologies using millimeter-wave and sub-millimeter wave frequencies for mobile communications applications, where the Commission already has established power density limits across these frequencies, but we seek comment below on localized exposure limits for devices held close to the body. Another example is new wireless power transfer (WPT) technologies, including some that are designed to dynamically focus energy on a device at a distance. where, particularly for inductive WPT equipment, the Commission already has established power density limits across many of the frequencies being used for such technology, but we seek comment below on internal electric field limits, where appropriate. These and other similar applications of RF energy being developed raise questions as to how to determine compliance with the RF exposure limits.

120. In this *NPRM*, we seek comment on expanding the range of frequencies for which the RF exposure limits apply; (noting that exposure limits are already in effect from 100 kHz to 100 GHz) on incorporating into our rules localized exposure limits above 6 GHz in parallel to the localized exposure limits already established below 6 GHz; on specifying the conditions under which and the methods by which the limits are averaged, in both time and area, during evaluation for compliance with the rules; and on addressing new issues raised by WPT devices. Although we terminated the *Inquiry* noticed in ET Docket No. 13-84 above,³¹⁵ there are some proposals on which we seek comment in this *NPRM* that stem from matters discussed in that proceeding,³¹⁶ some of which overlap with the issues identified immediately above.³¹⁷

121. This *NPRM* proposes methods and seeks comment on how to best incorporate new RF technologies, new methods and techniques for RF transmission, and new usages for a variety of RF spectrum bands into our preexisting exposure framework. In particular, on the topic of body-worn spacing during testing of cell phones, we continue to strive to ensure that such spacing represents realistic values for present-day technology and common usage.³¹⁸ The new technology and use of frequencies acknowledged in the *2013 RF Order and Notice* but not directly addressed in our rules, and the consequent testing methods they entail,³¹⁹ are also addressed in this *NPRM*. As part of this effort, we also further explore the issue of approval for equipment using new methods and technologies. With respect to any special considerations for children and consumer information, we refer to the FDA website, which states that “[t]he scientific evidence does not show a danger to any users of cell phones from RF

³¹⁵ See *supra* Section III.

³¹⁶ See *RF Order and Notice*, 28 FCC Red at 3570-89, paras. 205-52.

³¹⁷ The comments from that proceeding will not be included in the instant docket, as the overwhelming majority of those comments are unrelated to the issues raised in this docket and those that are relevant here are typically intermingled in the same filings as unrelated comments. Parties should refile in this docket any information or comments that they deem to be still relevant to the specific proposals in this docket.

³¹⁸ See, e.g., KDB Publication 447498.

³¹⁹ *2013 RF Order and Notice*, 28 FCC Red at 3580, para. 229.

exposure, including children and teenagers.”³²⁰ In general, we will update the information on our website as may be necessary to satisfy our commitment to ensure compliance with established exposure limits without expressing opinions on potential long-term health impact or current research activities where this is a more appropriate role for the health agencies. Finally, we will provide information to the public that is useful in understanding our rules and the way they will be enforced.³²¹

A. Extension of Exposure Limits to Additional Frequencies

122. Our RF exposure rules provide that specific absorption rate (SAR) will be evaluated within the frequency range of 100 kHz to 6 GHz and, similarly, they provide for evaluation of maximum permissible exposure (MPE) field strength and power density within the frequency range of 300 kHz and 100 GHz.³²² The standards for localized specific absorption rate (SAR) that are normally applied for testing compliance of consumer devices operating below 6 GHz were derived from the Maximum Permissible Exposure (MPE) whole body limits. The Commission currently employs a similar derivation to apply localized limits where appropriate for testing consumer devices operating above 6 GHz. This approach, however, is not formalized in our rules. We most recently invited comments in the *2013 RF Order and Notice* as to whether the Commission should establish specific exposure limits and measurement protocols outside these frequency ranges.³²³ We noted that some inductive wireless chargers operate at frequencies below 100 kHz, and Commission staff has been approached by parties seeking guidance on how to determine compliance for wireless car chargers generally operating at similarly low frequencies.³²⁴ We are aware of three extant guidelines for RF exposure that extend to frequencies below 100 kHz: ICNIRP 2010,³²⁵ IEEE Std C95.1-2005,³²⁶ and more recently, Health Canada

³²⁰ U.S. Food and Drug Administration, Children and Cell Phones, <https://www.fda.gov/radiation-emitting-products/cell-phones/children-and-cell-phones>; see also *Statement from Jeffrey Shuren, M.D., J.D., director of the FDA’s Center for Devices and Radiological Health on the recent National Toxicology Program draft report on radiofrequency energy exposure* (Feb. 2, 2018), <https://www.fda.gov/news-events/press-announcements/statement-jeffrey-shuren-md-jd-director-fdas-center-devices-and-radiological-health-recent-national> (“I want to underscore that based on our ongoing evaluation of this issue and taking into account all available scientific evidence we have received, we have not found sufficient evidence that there are adverse health effects in humans caused by exposures at or under the current radiofrequency energy exposure limits. Even with frequent daily use by the vast majority of adults, we have not seen an increase in events like brain tumors. Based on this current information, we believe the current safety limits for cell phones are acceptable for protecting the public health.”).

³²¹ We acknowledged in the *Inquiry* the guidance given by WHO that extra precautionary efforts, such as providing information describing effective means for the public to reduce exposure below recognized scientifically-based limits, is considered by the WHO to be unnecessary but acceptable so long as such efforts do not undermine exposure limits based on known adverse effects. See World Health Organization (WHO), *Model Legislation for Electromagnetic Fields Protection*, Articles 2.1, 7.4 and 7.5, 2006, ISBN 978 92 4 159432 5, http://www.who.int/peh-emf/standards/EMF_model_legislation_2007.pdf?ua=1.

³²² See 47 CFR § 1.1310 Radiofrequency radiation exposure limits. The Commission’s fundamental responsibility with respect to health risk to humans for all RF devices is expressed in section 1.1307 of our rules (47 CFR § 1.1307) and our OET has provided case-by-case guidance on WPT issues.

³²³ *2013 RF Order and Notice*, 28 FCC Rcd at 3580, para. 229.

³²⁴ See *2013 RF Order and Notice*, 28 FCC Rcd at 3580, para. 229.

³²⁵ International Commission on Non-Ionizing Radiation Protection (ICNIRP) *Guidelines for Limiting Exposure to Time-Varying Electric and Magnetic Fields (1 Hz - 100 kHz)*, Health Physics 99(6): 818-836, 2010. ICNIRP Publication – 2010, available at <http://www.icnirp.org>.

³²⁶ Institute of Electrical and Electronics Engineers, Inc. (IEEE) *Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*, IEEE Std C95.1-2005, copyright 2006 by IEEE, New York, New York 10016-5997. See also the recently published (October 4, 2019) Institute of Electrical and Electronics Engineers, Inc. (IEEE) *Standard for Safety Levels with Respect to Human Exposure to Electric*,

(continued....)

Safety Code 6 (2015).³²⁷ All of these guidelines are aimed at prevention of electrostimulation due to RF electric fields induced internally within the human body in the presence of an external electromagnetic field outside the body—the primary human reaction to electromagnetic field energy at these frequencies. The internal electric field (E_i) would be analogous to SAR as an internal dosimetric measure, in contrast to the MPE limits on external fields, but where SAR is intended to prevent excessive body heating, the internal electric field avoids neural stimulation effects unrelated to heating.³²⁸ The three standards have similar values for limiting the internal electric field (E_i), although they have rather different approaches to the dosimetry used to derive their respective MPE limits on external fields from those E_i values. We seek comment on the significance of the differences among the preceding three guidelines.

123. While each of the standards appear to provide appropriate E_i guidelines, the ICNIRP 2010 guidelines are the most recent that are widely accepted internationally.³²⁹ Accordingly, we propose to adopt limits on E_i similar to these ICNIRP 2010 guidelines in our rules for frequencies between 3 kHz to 10 MHz. We do not propose to apply these guidelines below 3 kHz because our table of frequency allocations begins at 8.3 kHz and there are no established provisions for devices to operate at lower frequencies.³³⁰ We seek comments on these proposals and on other relevant and authoritative standards that commenters deem appropriate for consideration.

124. We propose to overlay ICNIRP 2010 electrostimulation limits for E_i on our existing SAR limits for frequencies between 100 kHz and 10 MHz. Because of the fast response of neural stimulation relative to heating, it is appropriate to apply electrostimulation limits without time averaging (in addition to time-averaged SAR limits) to fields at frequencies well above 100 kHz.³³¹ However, we do not propose to amend or extend our MPE limits on external fields.³³² This would place E_i alongside SAR as a

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Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz, IEEE Std C95.1-2019, copyright 2019 by IEEE, New York, New York 10016-5997.

³²⁷ Health Canada Safety Code 6 - *Limits of Human Exposure to Radiofrequency Electromagnetic Energy in the Frequency Range from 3 kHz to 300 GHz (2015)*, available at http://www.hc-sc.gc.ca/ewh-semt/consult/2014/safety_code_6-code_securite_6/final_finale-eng.php (last accessed March 14, 2018).

³²⁸ Adverse neural stimulation effects mentioned by these standards include acute effects such as perception of tingling, shock, pain, or altered behavior due to excitation of tissue in the body's peripheral nervous system. Applications in these frequencies include wireless power transfer technologies associated with charging electrical vehicles. We note that the Society of Automotive Engineers (SAE) standard J2954 for automotive WPT has called for compliance with ICNIRP 2010. See https://www.sae.org/standards/content/j2954_201605/.

³²⁹ For example, at least Germany, Japan, China, and Canada so far have adopted limits consistent with ICNIRP 2010, either by adopting limits derived based on similar considerations or directly by reference. (For example, Canada has adopted its recently updated Safety Code 6 which specifies the same internal electric field limits as ICNIRP 2010, while Germany and Japan have explicitly cited ICNIRP 2010 in their regulations.) See, e.g., <https://www.qualcomm.com/media/documents/files/requirements-for-human-exposure-assessment-of-wireless-electric-vehicle-charging-wevc-systems.pdf>.

³³⁰ 47 CFR § 2.106.

³³¹ Neural stimulation time constants are measured in hundreds of microseconds (see *Applied Bioelectricity*, Reilly, J. P., p. 246, Tbl. 1 (1998)), as compared to thermal time constants for RF heating of skin of typically measured in tens or hundreds of seconds (see *Thermal Response of Human Skin to Microwave Energy: A Critical Review*, Foster, K. R., et. al., Health Physics, Vol. 111, Issue 6, p. 530, Figure 2 (2016)).

³³² We note that, except under rare circumstances, the MPE and SAR limits will be the predominantly more restrictive limits above a about few hundred kHz. In other words, MPE and SAR exposure limits will reliably protect against any adverse tissue heating resulting from most (if not all) communications sources of RF energy regulated by the Commission, while the proposed internal electric field limit will protect against any adverse electrostimulation responses in nervous tissue not directly related to heating, such as extremely fast, short-duration pulses of RF energy not common for communications devices over the frequency range in which these limits would apply. Thus, although we expect that most RF sources will be unaffected by this proposed change, preventing

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co-primary limit³³³ between 100 kHz and 10 MHz and continues our policy that MPE limits are secondary.³³⁴ Guidance on how to comply with both limits within this frequency range may be developed as necessary for particular applications.³³⁵ We seek comment on these proposed numerical limits, and on the guidance demonstrating compliance with such limits

125. As technologies push the boundaries into spectrum ranges not previously used or anticipated, we now contemplate new rules on how to determine RF exposure compliance at these frequencies and eliminate uncertainty that may delay investment and development of new technologies. The Commission has no specific RF exposure limits above 100 GHz for new licensed services and unlicensed devices.³³⁶ Although the radio spectrum is managed up to 3,000 GHz (3 THz), our exposure limits are currently specified only up to 100 GHz.³³⁷ And since the exposure limits are constant from 6 GHz all the way up to 100 GHz³³⁸ (due to minimal body penetration), these limits could in principle be applied up to far infrared wavelengths.³³⁹

126. We are unaware of any reason the limits should be different above 100 GHz than across the already existing wide frequency range. As the difference in body penetration further diminishes towards zero, there is no apparent reason to expect that thermal effects will effectively change in the increasingly higher frequencies. Accordingly, we propose to extend the same constant exposure limits that presently apply from 6 GHz to 100 GHz up to an upper frequency of 3,000 GHz (3 THz), which is considered to be the upper bound of existing radiofrequency bands.³⁴⁰ Starting at 300 GHz or a wavelength of 1,000 micrometers (μm), standards have been developed for lasers primarily for application in industrial settings.³⁴¹ In an effort by standards bodies to match the laser standards, RF limits have been increased at millimeter wave frequencies;³⁴² however, we do not feel it is appropriate to

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electrostimulation effects, even under rare circumstances, is necessary to protect the public consistent with our obligations under NEPA.

³³³ This means that both E_i and SAR limits must be met between 100 kHz and 10 MHz.

³³⁴ See 47 CFR § 1.1310(a) (“Specific absorption rate (SAR) shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in § 1.1307(b) within the frequency range of 100 kHz to 6 GHz (inclusive).”); see also *2013 RF Order and Notice*, 28 FCC Rcd at 3506-09, paras. 20-27 (“Primacy of Specific Absorption Rate (SAR) over Power Density or Field Strength below 6 GHz”).

³³⁵ We propose that our policy on recommended best practices for evaluation techniques to comply with both E_i and SAR in the frequency range between 100 kHz and 10 MHz should be contained in our Bulletins and in other supplemental materials, such as the OET Laboratory Knowledge Database (KDB).

³³⁶ See *Spectrum Horizons*, First Report and Order, FCC 19-19, para. 43 (Mar. 15, 2019) (*Spectrum Horizons R&O*); see also *Spectrum Horizons*, Notice of Proposed Rule Making, 33 FCC Rcd 2438, 2473, para. 82 (2018) (*Spectrum Horizons NPRM*).

³³⁷ *Id.*

³³⁸ See 47 CFR § 1.1310. The power density limits specified for general population and occupational exposure for 1.5 GHz up to 100 GHz are 1 mW/cm² and 5 mW/cm² respectively for whole-body continuous exposure.

³³⁹ *Spectrum Horizons R&O*, at para. 43.

³⁴⁰ We note over the frequency range between 1.5 GHz and 6 GHz that the power density limits specified for general population and occupational exposure are 1 mW/cm² and 5 mW/cm² respectively for whole-body continuous exposure.

³⁴¹ See, e.g., International Commission on Non-Ionizing Radiation Protection (ICNIRP) *Guidelines on Limits of Exposure to Laser Radiation of Wavelengths between 180 nm and 1,000 μm* , Health Physics 105(3):271-295; 2013. ICNIRP Publication – 2013, available at <http://www.icnirp.org>.

³⁴² See, e.g., International Commission on Non-Ionizing Radiation Protection (ICNIRP), *Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (Up to 300 GHz)*, 74 Health Physics 494 (continued....)

relax our limits at higher frequencies for exposure from consumer communication devices, considering the already minimal skin depth at 100 GHz. Accordingly, we propose to extend our existing limits to 3,000 GHz (3 THz) to stay ahead of the possibility of technologies being introduced that are only nascent or unknown today. We note that most of the services being contemplated in the *Spectrum Horizons* proceeding are within 95-275 GHz frequencies,³⁴³ but there may be other potential applications or services being contemplated above these frequency bands. We seek comment on this proposal. Specifically, we seek comment on the frequency range over which these proposed limits would apply.

1. Localized Exposure Limit for Higher Frequencies

127. Newer technologies that employ techniques such as adaptive array antennas created by fluctuating multi-beam sources create complex electromagnetic fields that present challenges for present-day RF measurement methods.³⁴⁴ The Commission's RF exposure rules do not yet specify a spatial maximum power density limit for localized exposure at higher frequencies.³⁴⁵ As portable devices are being developed for operation at higher frequencies for future 5G services in millimeter-wave bands, we propose a general localized power density exposure limit above 6 GHz of 4 mW/cm² averaged over 1 cm² for the general population or uncontrolled exposure, applicable up to the upper frequency boundary of 3 THz, also proposed above.³⁴⁶ We invite comments on this proposal. Both the ICNIRP guidelines and the IEEE standards specify a spatial maximum power density, at least at higher frequencies (*e.g.*, between 3GHz and 10 GHz) of 20 times the whole-body MPE limit, generally averaged over 1 cm².³⁴⁷ We also propose a localized exposure limit above 6 GHz for occupational or controlled exposure of 20 mW/cm² averaged over 1 cm², which is consistent with the typical increased ratio of 5:1 for the occupational limits

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(1998); Institute of Electrical and Electronics Engineers, Inc. (IEEE), IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, IEEE Std C95.1-2005 (2006).

³⁴³ *Spectrum Horizons R&O*, FCC 19-19, para. 11; *Spectrum Horizons NPRM*, 33 FCC Rcd 2438, 2473, para. 82.

³⁴⁴ *Use of Spectrum Bands above 24 GHz for Mobile Radio Services*, Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd 8014, 8140-44, paras. 356-63 (2016) (*2016 Spectrum Frontiers R&O and FNPRM*). Separate from the leveraging of this beamforming technology for use in communications applications such as those being contemplated for 5G, some WPT applications contemplate utilizing directed RF energy to charge mobile devices from common household appliances such as washing machines. *See Could Your Washer Really Charge Your Smartphone From Across The Room?* at <http://www.engadget.com/2014/10/31/haier-energous-wireless-charging-really/>; *see also* <http://energous.com/technology/>; <http://www.witricity.com>.

³⁴⁵ Over the frequency range from 100 kHz through 6 GHz, our localized SAR limit for the general population is 1.6 W/kg as averaged over any one gram cube of tissue. (For occupational exposure over this same frequency range, the localized SAR limit is 8 W/kg as averaged over any one gram cube of tissue.) Similarly, at these frequencies, our whole-body SAR limit for the general population is 0.08 W/kg as averaged over the whole human body. (For occupational exposure, the whole-body SAR limit is 0.4 W/kg.) *See* 47 CFR § 1.1310(c): "The SAR limits for general population/uncontrolled exposure are 0.08 W/kg, as averaged over the whole body, and a peak spatial-average SAR of 1.6 W/kg, averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube)." *See also* 47 CFR § 1.1310(b) for occupational limits.

³⁴⁶ TIA Comments at 34-35; Qualcomm Comments, GN Docket No. 14-177, at 15-16.

³⁴⁷ International Commission on Non-Ionizing Radiation Protection (ICNIRP), *Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (Up to 300 GHz)*, 74 Health Physics 494 (1998); Institute of Electrical and Electronics Engineers, Inc. (IEEE), Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, IEEE Std C95.1-2005 (2006); Institute of Electrical and Electronics Engineers, Inc. (IEEE) *Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz*, IEEE Std C95.1-2019 (2019).

relative to the general population limits. We tentatively conclude not to adopt an extremity limit at this time.³⁴⁸

128. The proposed general population localized power density value of 4 mW/cm² matches the exposure limit specified at 6 GHz in the IEEE Std C95.1-1991 standard referenced in our rules.³⁴⁹ Our reading of the literature suggests that based on planar models, a power density of 4 mW/cm² just above 6 GHz is consistent with our 1-gram SAR limit of 1.6 W/kg at 6 GHz.³⁵⁰ Also, the thermal perception threshold at frequencies approaching 100 GHz for large areas of exposure is indicated at about 4 mW/cm².³⁵¹ Maintaining 4 mW/cm² across the entire frequency range (6 GHz to 3 THz) will avoid any potential discontinuity between SAR and power density limits at 6 GHz while also preventing the possibility of perception of warmth at higher millimeter wave frequencies.³⁵² We seek comment on all elements of this proposal. We seek comment on whether our lower-power exemptions above 6 GHz should be changed for a localized power density limit in this frequency range.³⁵³ Recognizing the ongoing work in standards bodies to establish limits on in-tissue power density in lieu of free-space power density—analogue to SAR below 6 GHz—we also seek comment on whether we should instead adopt such a limit, and if so what that limit should be, or if we should withhold consideration of an in-tissue power density limit until after the standards have been published at a later date. Commenters may also propose other approaches for determining appropriate exposure limits at higher frequencies, with their analysis and justification for using any such protocol.

2. Averaging Area for Higher Frequencies

129. In the *2016 Spectrum Frontiers R&O and FNPRM*, the Commission acknowledged as reasonable a spatial averaging area of 20 cm² for power density above 10 GHz—as provided by ICNIRP for a whole-body exposure limit.³⁵⁴ However, as we continue to consider this issue, we find little support in the technical literature for specifying a large averaging area with respect to the whole-body limit when there is also stipulated an averaging area for a spatial maximum limit for localized exposure. Moreover,

³⁴⁸ In general, specific extremity limits are only used where the basic restriction is SAR. See 47 CFR § 1.1310. They are not used at higher frequencies where power density is the basic limit and exposure is a more local phenomenon. See *id.*

³⁴⁹ The American National Standards Institute (ANSI), *IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields*, 3 kHz to 300 GHz, ANSI/IEEE Std C95.1-1992, Sections 4.1 and 4.2 (1991).

³⁵⁰ Gustrau and Bahr, *W-Band Investigation of Material Parameters, SAR Distribution, and Thermal Response in Human Tissue*, IEEE Transactions on Microwave Theory and Techniques, Vol. 50, No. 10, October 2002 and Colombi et al, *Implications of EMF Exposure Limits on Output Power Levels for 5G Devices above 6 GHz*, DOI 10.1109/LAWP.2015.2400331, IEEE Antennas and Wireless Propagation Letters. Table VI in this paper shows a 1-gram SAR of 0.24 W/kg at 6 GHz due to a power density of 1 mW/cm² which implies a power density of 6.67 mW/cm² would result our 1-gram SAR limit of 1.6 W/kg. Also, calculations based on Appx. D, Table D-1, D-2, and D-5 in the *2013 RF Order and Notice*, imply continuity at 3.42 to 3.94 mW/cm². See *2013 RF Order and Notice*, 28 FCC Rcd at 3626-32.

³⁵¹ Blick et al, *Thresholds of Microwave-Evoked Warmth Sensations in Human Skin*, Bioelectromagnetics 18:403–409 (1997). Long duration (10-s), large area (327-cm²) sensation threshold of the human back was measured as 4.5 ± 0.6 mW/cm² at 94 GHz. See also, e.g., IEEE Std C95.1-2019 (allowing an epithelial power density limit of up to 4 mW/cm² for the general public with an averaging area of 1 cm² above 30 GHz if the exposed area on the body surface is small). FCC's power density exposure limits are defined as plane-wave equivalent. See 47 CFR § 1.1310.

³⁵² See *2016 Spectrum Frontiers R&O and FNPRM*, 31 FCC Rcd at 8141, paras. 359-60 (noting that a commenter had pointed out the discontinuity between the SAR and MPE limits at 6 GHz).

³⁵³ See *supra* Section IV.A (adopting the 1 mW exemption and MPE-based exemption).

³⁵⁴ See *2016 Spectrum Frontiers R&O and Further Notice*, 31 FCC Rcd at 8142-43, para. 363.

ICNIRP maintains an averaging area of 1 cm² for spatial maximum power densities over the frequency range of 10 GHz to 300 GHz. There is growing consensus that a range of from one to a few square centimeters would be a more appropriate averaging area for localized spatial maximum power density limits rather than the much larger values (20 cm² or 100 cm²)³⁵⁵ that are provided for the whole-body limits in recent published versions of technical standards.³⁵⁶

130. We propose that a 1 cm² averaging area be applicable to localized exposure conditions where the averaged power density would not exceed 4 mW/cm² for the general population or uncontrolled exposure (20mW/cm² for occupational or controlled exposure). The 1 cm² area is approximately the same size as any of the surfaces of a 1 g cube used for portable device SAR evaluation below 6 GHz,³⁵⁷ and we also note that 4 mW/cm² averaged over 1 cm² would result in similar exposure as the guidance that the FCC Laboratory currently offers to allow 1 mW/cm² to be averaged over 4 cm² for pertinent equipment authorizations.³⁵⁸ We invite comment on this proposal. We also seek comment on whether it may also be appropriate to specify a spatial peak limit coupled with this 1 cm² averaging area to avoid significant excursions under actual non-uniform exposure conditions on a millimeter scale.³⁵⁹ We are aware that this 1 cm² averaging area is generally smaller than the actual size of antenna arrays being contemplated for use by millimeter-wave portable devices, and we seek comment on whether this presents insuperable or significant difficulties, and on other technically valid and practical alternatives.

B. Transmitter-Based and Device-Based Time-Averaging

131. Our RF exposure limits for consumer devices allow for source-based time-averaging, that is, based on inherent properties of the source that are not controlled or affected by the user.³⁶⁰ This is typically a function of an on/off duty cycle that is fundamental to the underlying transmission protocol used to support a device's operation. Our rules do not specify a limit for temporal-peak maximum SAR

³⁵⁵ Hirata, A., et. al., *Setting Exposure Guidelines and Product Safety Standards for Radio-Frequency Exposure at Frequencies Above 6 GHz: Brief Review*, Annals of Telecommunications, 74:17-24 (2019). See generally International Commission on Non-Ionizing Radiation Protection (ICNIRP), *Draft ICNIRP Guidelines, Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic and Electromagnetic Fields (100 kHz TO 300 GHz)*, Appx. A: Review of Studies on Dosimetry, section 3.3.2 ("Spatial averaging considerations"), p. 10, available at: https://www.icnirp.org/cms/upload/consultation_upload/ICNIRP_RF_Guidelines_PCD_Appx_A_2018_07_11.pdf (July 11, 2018). See also IEEE Std C95.1-2019 (specifying an averaging area of 4 cm² below 30 GHz and 1 cm² above 30 GHz).

³⁵⁶ International Commission on Non-Ionizing Radiation Protection (ICNIRP), *Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (Up to 300 GHz)*, 74 Health Physics 494 (1998) (ICNIRP Guidelines 300 GHz); Institute of Electrical and Electronics Engineers, Inc. (IEEE), IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, IEEE Std C95.1-2005 (2006). But see IEEE, *Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz*, IEEE Std C95.1-2019 (2019).

³⁵⁷ 47 CFR § 1.1310(c).

³⁵⁸ See FCC Office of Engineering and Technology, Telecommunication Certification Body (TCB) Presentations, RF Exposure: Order/NPRM Issues at 12 (Oct. 2018), <https://transition.fcc.gov/oet/ea/presentations/files/oct18/5.1-TCB-RF-Exposure-OrderNPRM-Issues-MD.pdf>.

³⁵⁹ Hashimoto, Y., et. al., *On the Averaging Area for Incident Power Density for Human Exposure Limits at Frequencies Over 6 GHz*, Physics in Medicine and Biology, 62:3124-3138 (2017); see also *Use of Spectrum Bands above 24 GHz for Mobile Radio Services*, Notice of Proposed Rulemaking, 30 FCC Rcd 11878, 11974-75 para. 324 & n.574, (2015) (noting that no comments were received in response to our solicitation of comment on the adequacy of our 2013 exemption proposals based on a 1 cm² averaging area in preventing exposure over our limits, for example, in a situation involving multiple high-gain millimeter-wave radiators); *2013 RF Order and Notice* 28 FCC Rcd at 3539, para. 126.

³⁶⁰ 47 CFR §§ 2.1091(d)(2) and 2.1093(d)(5).

or power density during any time-averaging period.³⁶¹ In Sections 2.1091(d)(2) and 2.1093(d)(5) of our existing rules, portable and mobile consumer devices generally may not use the 30-minute averaging time specified in Section 1.1310.³⁶² The rationale for restricting time averaging to source-based functions was that devices whose usage (and consequent power output) is controlled by consumers could not be guaranteed to operate only for the percentage of time upon which its time-averaged compliance was based.³⁶³ This computed average assumes continuous operation at maximum power and duty cycle, which is consistent with the maximum possible exposure over indefinite time periods.

132. In their comments to the *2013 RF Further Notice*, manufacturers asserted that the foreclosure of time-averaging the short bursts of data transmissions is unnecessarily constraining the capability to offer increasing data capacity for consumer devices, particularly when tested for compliance with zero spacing, such as for a notebook computer or a tablet used close to the body.³⁶⁴ Recent technology has been developed to allow for the optimization of the time-averaged transmit power of a device over a predefined time window, using past transmit power levels as a reference to determine the maximum time-averaged SAR over that period.³⁶⁵ Based on the device's own management of time-averaged SAR, a maximum allowable transmit power for a future fixed time interval would be determined, and the device would then operate at a power equal to or less than the maximum allowable transmitter power, depending on factors such as the amount of data to be transmitted and network conditions. The device would either back off from a higher transmitter power to a lower power when the calculated time-averaged SAR approaches the SAR limit, or it could transmit at a higher power when the device gains an additional margin between the calculated time-averaged SAR and the SAR limit. In considering such proposals and to be consistent with our established RF exposure limits, several questions related to this type of implementation need to be considered.

133. Many wireless devices (e.g., 4G LTE) transmit in short bursts that are variable depending on operational network and user demands. The present rules for source-based time-averaging do not account for the variable nature of such transmissions. The new technology being developed utilizes both the power level and time-averaging duration in a dynamic manner, depending on the device operating conditions, to determine SAR compliance in real-time.³⁶⁶ We propose that such active accounting and control of the instantaneous output power of the device be defined as *device-based time-averaging*, in our rules, because we expect, especially for portable devices with multiple transmitters, that the cumulative transmissions from all RF sources in the device be accounted for in the SAR margin calculations. We recognize that a device may have more than one RF source, some of which might be power-controlled by the device and others which might not, and so we seek comment on how to reliably and predictably distinguish any such device from a conventional device intending to be certified under our existing source-based time-averaging rules.

³⁶¹ This is consistent with NCRP Report 86, sections 17.4.3 and 17.4.8.

³⁶² An example described in our existing rules where source-based time averaging is appropriate would be consideration of the inherent transmission duty-cycle in determining exposure from a device that employs a time-division multiple-access (TDMA) scheme.

³⁶³ See generally, 1996 Order 11 FCC Rcd 15123. For example, push-to-talk capabilities cannot guarantee that a device would not be used over a longer period than assumed for the averaging or even for the entire 30-minute period, pushing the exposure over the average limit permitted.

³⁶⁴ See TIA Comments at 9-11, Qualcomm Reply Comments at 1, CTA Comments at 4, 9-10, MWF Comments at 28-29, and HP Comments at 1-2.

³⁶⁵ Real-Time Specific Absorption Rate Implementation in Wireless Devices, U.S. Patent No. 9,622,187 B2 (issued April 11, 2017).

³⁶⁶ For example, a device could temporarily increase power to accommodate a high upload rate and/or poor propagation conditions, and then reduce power during less demanding periods based on the available SAR margin for the designated time-averaging period.

134. We seek comment on whether to permit this device-based time-averaging where the instantaneous transmit power and duration of each transmission burst can be managed by the device over some time period in a way that will ensure compliance with the RF exposure rules. We also seek input as to what specifications we should adopt that will confirm compliance and be applied clearly and consistently to devices coming on the market. We propose to allow a practical extension of our existing “source-based” definition in our rules to include “device-based” time-averaging. By adding this definition, we distinguish such a device from those already being authorized and recognize its responsiveness and applicability to an individual RF source while compliance is ultimately controlled by the device based on the device tracking transmission bursts and power levels over time.

135. It is unclear how SAR measurement results based on static conditions at certain power levels may be applied to evaluate device compliance for dynamic conditions where both operational and user exposure conditions are continuously changing. It will be necessary to select the various parameters for applying device-based time-averaging to non-periodic transmissions that are apparently random and dynamic, which can be influenced by device operating configurations, network and propagation conditions and user operating conditions to ensure that the final measured exposure values still provide sufficient margins for various use configurations. We seek comment on the range and type of parameters that need consideration to apply the proposed time-averaging principles. For example, is it possible to develop one or more standard transmission sequences that would reasonably replicate typical operating conditions? Alternatively, would the averaging be demonstrated through representations of the device’s software and how would this be validated? How do we ensure the device software/firmware achieves compliance? We seek comment on the above and any other factors as they may relate to consideration of device-based time-averaging in the equipment authorization process.

136. With respect to the appropriate time-averaging period, we note two references for specifying time-averaging limits: (1) the ICNIRP standard provides for averaging over 6 minutes at 10 GHz and reduces to 10 seconds at 300 GHz on a complex basis,³⁶⁷ and (2) the IEEE standard has an averaging time of 25 minutes at 6 GHz dropping to 10 seconds at 300 GHz.³⁶⁸ However, since we do not limit temporal-peak SAR or power density, all the energy available in a time-averaging period could be deposited in a moment resulting in a well-defined temperature rise and be compliant with the rules. Thus, using the extended time-averaging periods of 6 minutes or 30 minutes set forth in our rules in other contexts or either of the alternative time windows specified by ICNIRP and IEEE could allow for inappropriate temperature rises in extreme cases when intense exposure occurs only for a brief period. By reducing the time-averaging period, the maximum possible temperature rise can be limited to a reasonable quantity. The potential temperature rise (ΔT) due to an impulse exposure is proportional to the product of the allowed continuous-spatial-peak SAR (SAR_{csp}) and the time-averaging period (Δt), so that a maximum time-averaging period (Δt) can be calculated from a specified temperature rise (ΔT) from $\Delta t = c \cdot \Delta T / SAR_{csp}$ where c is the specific heat of tissue. SAR_{csp} at higher frequencies occurs at the skin surface, depends on the SAR or power density limit (for this calculation 1.6 mW/g or 4.0 mW/cm²) and on the depth of energy absorption into tissue, and this depth in turn depends on frequency. Determination of SAR_{csp} was approached with standard calculations using a planar model of uniform dry skin.³⁶⁹ Based on this approach, 100 seconds is a supportable averaging time up to about 3 GHz, with smaller averaging times down to a second at higher frequencies. This would permit a device to actively track its RF

³⁶⁷ International Commission on Non-Ionizing Radiation Protection (ICNIRP), *Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (Up to 300 GHz)*, 74 Health Physics 494 (1998).

³⁶⁸ Institute of Electrical and Electronics Engineers, Inc. (IEEE), *IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*, IEEE Std C95.1-2005, (2006); see also IEEE, *Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz*, IEEE Std C95.1-2019 (2019).

³⁶⁹ Kenneth R. Foster et al, *Thermal Response of Human Skin to Microwave Energy: A Critical Review*, 111 Health Phys. 528–541 (2016).

emissions while limiting potential temperature rise in tissue due to an impulse to value of about 0.1 °C, less than would be perceptible by the general population.³⁷⁰ Therefore, we propose and seek comment on the following maximum time windows to be allowed for any frequency for devices seeking to implement device-based time-averaging techniques:

Table 3 – Proposed Maximum Averaging Times for Device-Based Time-Averaging.

Frequency (GHz):	< 2.9	2.9-7.125	7.125-10.5	10.5-15.4	15.4-24	24-37	37-53	53-95	> 95
Time (seconds):	100	49	27	14	7	4	3	2	1

In deriving this table, as a matter of simplicity and practicality, we looked at the bands and bandwidth we expect will be used for various types of devices and services, and provide distinct parameters for each frequency range. Comments are welcome on this approach and whether we have best delineated the frequency ranges for the purpose of time-averaging limits. Any comment should include a rigorous technical analysis in support of the position it advocates.

C. Wireless Power Transfer Devices

137. A characteristic example of the technical advancement of wireless devices is the development and evolution of wireless power transfer devices. Such devices are not intended for communications, but instead allow for the transmission of electrical energy without the use of wires or other physical connections. Specifically, the primary device is a transmitting unit that conveys RF energy to one or several secondary devices that act as receiving units, to charge or power the receiving unit. The most familiar consumer applications of wireless power transfer technology are charging pads or fixtures for charging the batteries in cell phones, electronic toothbrushes, kitchen appliances, and cordless tools. Most of these products have been designed to operate via magnetic induction³⁷¹ or resonance³⁷² techniques, where the device is placed on a charger with little or no distance separation between the power source (transmitting unit) and the battery or appliance (receiving unit). Most of the existing applications are for battery charging, and charge only one device at a time and at low power. However, use of wireless power transfer for powering of devices and charging of multiple devices at once is increasing, and charging (or powering) of devices while in motion is being developed.

138. Certain new wireless power transfer applications, while designed for relatively close coupling between the transmitting and the receiving units, can operate at very high power (e.g., higher than 3 kW and up to several tens of kW), and at a variety of frequencies below 100 kHz.³⁷³ Other

³⁷⁰ Kenneth R. Foster et al, *Heating of Tissues by Microwaves: A Model Analysis*, 19 Bioelectromagnetics 420–428 (1998) and Joseph C. Stevens and Kenneth K. Choo, *Temperature Sensitivity of the Body Surface over the Life Span*, 15 Somatosensory & Motor Research 13-28 (1998).

³⁷¹ A typical *magnetic inductive* wireless power transfer system has two separate components: a transfer unit, or “charger”, which connects to a wall outlet and a receiver (the “charged” unit, which receives the power). Radio frequency (RF) energy generated in a coil circuit (primary coil) in the charger is coupled through the air to another functional coil circuit (secondary coil) residing in the receiving unit where it is used to charge a battery circuit, or to directly power different components. There is no wire between the charger and charged devices.

³⁷² In wireless power transfer using *magnetic resonance*, the two coils from the charger and charged devices resonate at the same frequency to enhance the efficiency of the magnetic coupling despite the greater distance between them. Because other receiving coils (or any other object for that matter) would not resonate at the same frequency as the transfer coil in the absence of intentional and precise tuning, only the targeted receiving unit can be charged, making power transfer highly selective even at a distance.

³⁷³ For example, the Society of Automotive Engineers SAE Surface Vehicle Information Report J2954 (Nov 2017) for light-duty vehicles (e.g., cars), specifies a common operating frequency range of 81.38 kHz to 90.00 kHz. See https://www.sae.org/standards/content/j2954_201605/. Certain international standards specify various frequency

(continued....)

advanced wireless power transfer applications can provide charging from a transmitting unit to one or more receiving unit(s) located at greater distances (one meter or more) from the transmitting unit, with future developments intended at distances suitable for room-size operation, and while the receiving unit is in motion.³⁷⁴ These new devices also create significant measurement challenges since the beam forming provided by the antenna technologies is dynamic and can vary in time and space based on the detection of obstruction between the transmitting and receiving units.³⁷⁵

139. *Definition.* Wireless power transfer devices have been authorized for several years under the Commission's Part 15³⁷⁶ and Part 18³⁷⁷ rules, depending on whether any communication function is involved between the transmitting and receiving units.³⁷⁸ As these new and enhanced wireless power transfer products, currently under development, will seek a ubiquitous position in modern households and workplaces and will require unique considerations in our equipment authorization process, we propose to define wireless power transfer devices under Part 18 of our rules as:

A category of ISM equipment which generates and emits RF energy for local use by inductive, capacitive or radiative coupling, for transfer of electromagnetic energy between a power transfer unit (TU) and receiving unit(s) (RU) of a Wireless Power Transfer (WPT) system.

140. We seek comment on the proposed definition. Is there an alternative definition that would better reflect the technological developments in this area? We also seek to allow limited non-communications feedback—for example, the receiving unit modulates its resistance to create a “feedback” to the transmitting unit to indicate its charge level—as compliant with Part 18 rules.³⁷⁹ Based on our discussion of wireless power transfer *locally operated* and *at-a-distance* devices below, should we also consider a separate definition for wireless power transfer equipment that provides charging of receiving units located at a distance from the transfer unit, as this type of equipment may not meet the above proposed definition for “local” operation? We invite comments and input on these issues.

141. *Locally operated wireless power transfer system.* Part 18 allows the use of potentially unlimited power if a device operates within a designated Industrial, Scientific and Medical (ISM) frequency band,³⁸⁰ so long as the device operates “locally.”³⁸¹ Because the rules do not define what would

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ranges for WPT in general. See ETSI EN 303 417 V1.1.1 (2017-09), *Wireless power transmission systems, using technologies other than radio frequency beam in the 19-21 kHz, 59-61 kHz, 79-90 kHz, 100-300 kHz, 6765-6795 kHz ranges; Harmonized Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU* (Sept. 2017).

³⁷⁴ See e.g., <http://www.energous.com>; <http://www.ossia.com>.

³⁷⁵ See, e.g., Energous Corporation, FCC ID 2ADNG-MS300.

³⁷⁶ 47 CFR §§ 15.1 *et seq.*; see, e.g., Powercast Corporation, FCC ID YEST91503. WPT devices may operate under Part 15 of the Commission's rules as generic unlicensed devices.

³⁷⁷ 47 CFR §§ 18.1 *et seq.*; see, e.g., Energous Corporation, FCC ID 2ADNG-MS300. WPT devices may operate under Part 18 of the Commission's rules under the category “miscellaneous ISM equipment”. 47 CFR § 18.305(b).

³⁷⁸ To address WPT power transfer at a distance, the OET Laboratory has been providing guidance on a case-by-case basis. See, e.g., Energous Corporation, FCC ID 2ADNG-MS300. Also, OET has provided general guidance through KDB publications for compliance with our rules on nascent or evolving technologies such as WPT. The OET Laboratory will continue to provide guidance on WPT until final rules are adopted.

³⁷⁹ Section 18.107(c) defines ISM equipment as “[e]quipment or appliances designed to generate and use locally RF energy for industrial, scientific, medical, domestic or similar purposes, *excluding applications in the field of telecommunication*,” 47 CFR § 18.107(c) (emphasis added,) therefore, data transmission for communications purposes is prohibited for ISM equipment. However, the Commission has issued guidance to allow such limited communications under Part 18 rules for WPT equipment. See KDB Publication 680106 at <https://apps.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?id=41701&switch=P>.

³⁸⁰ There are eleven (11) designated ISM frequency bands with specific bandwidths. See 47 CFR § 18.301.

constitute “local” usage, measurement and compliance challenges arise in assessing wireless power transfer devices that provide charging of receiving units located at a distance from the wireless power transfer transmitting unit. We seek comment on whether the term “local” should be defined in terms of distance between the transmitting and receiving units. If we define “local” based on this distance, what is the maximum distance between the transmitting and receiving units that should be considered as “local” operation?

142. We note that CISPR³⁸² is considering a definition for the primary device of a wireless power transfer system that states that the term “local” is used differently in the context of wireless power transfer from other ISM devices: “for the case of WPT systems that operate inductively, ‘local’” may imply that the separation distance between the primary (TU) and secondary (RU) WPT devices should not be greater than 50 centimeters (cm).”³⁸³ Based on CISPR’s proposal, should we use 50 cm as the maximum distance for wireless power transfer devices that operate “locally” (excluding wireless power transfer at-a-distance devices, as discussed below) under Part 18?

143. *Wireless power transfer at-a-distance.* We seek comment on a suitable definition and operating parameters for wireless power transfer devices that provide charging of receiving units located at a distance from the power transfer unit (*i.e.*, 50 cm or greater), with future developments intended at distances suitable for room-size operation, and while the RU is in motion.³⁸⁴ This would cover wireless power transfer devices that do not meet the definition of a locally operated wireless power transfer device, *i.e.*, within a proposed maximum distance between the transmitting and receiving unit(s) as discussed above. Should we consider the size and coherence of the electromagnetic field created, rather than its distance from the transmitting unit? The challenge with these types of wireless power transfer devices is that charging at a distance can create an RF field distribution in three dimensions with an undefined or

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³⁸¹ 47 CFR § 18.107 requires ISM equipment “to generate and use locally RF energy.” The Commission’s rules as well as other international standards do not quantify a specific distance for the term “local.” The reason to limit RF energy to “local use” in Part 18 is to prevent high-power RF energy reaching outside the immediate vicinity of the RF generator source, which is allowed to operate at unlimited power to perform “work” (non-communication functions) within the designated ISM frequency bands. *See* 47 CFR § 18.305(a). Microwave ovens are probably the best-known example of ISM consumer equipment in that they generate RF energy and use that energy locally to heat food within the shielded oven structure. We note that CISPR has been actively involved in this area, *see, e.g.*, CIS/B/710/CD (Aug. 2018), in which a “local” distance for WPT device should not be greater than 50 centimeters (~20 inches). A proposal is also being considered by CISPR for WPT at-a-distance devices, proposing distances up to 10 meters (30 feet) between the transmitting and the receiving units. In addition, so-called “wireless power transmission” has been under consideration in ITU-R since the 1997 initiation of their ongoing Communication Study Group 1, ITU-R 210 3/1, <http://www.itu.int/pub/R-QUE-SG01.210>.

³⁸² CISPR (Comité International Spécial des Perturbations Radioélectriques in French, International Special Committee on Radio Interference in English) is a standards setting body that is part of the International Electrotechnical Commission (IEC), which established international standards to control electromagnetic interference in electrical and electronic devices.

³⁸³ *See* CIS/B/710/CD, Committee Draft, “Amendment 3 Fragment 1 to CISPR 11 Ed. 6: Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement - Requirements for air-gap wireless power transfer (WPT),” (August 2018); CIS/B/717/CC, “Compilation of Comments on CIS/B/710/CD,” (October 2018).

³⁸⁴ *See e.g.*, Office of Engineering and Technology Seeks Comment on Auspion USA, Inc. Request for Waiver of ISM “Local Use” Requirement in Parts 2 and 18 for a 24 GHz Wireless Power Transfer Device Over Distance, DA 19-211 (OET Mar. 26, 2019). GuRu (formerly Auspion) requests to operate a wireless charging system using the 24 GHz ISM band to charge receiving devices located at distances greater than 3 feet (1 meter) from the charging unit. GuRu is effectively requesting the Commission to waive the “local” definition to allow ISM devices that “...employ phased arrays [antennas] to focus the energy within a small volume of space at a defined location within a relatively short distance (approximately a few meters [more than 1 meter])” to operate under Part 18 ISM definition.

varying beam shape depending on the design. Moreover, the location of maximum RF exposure will be an area where various beams intersect, and the direction/location and intensity of the beams can change with the location of the target receiving unit(s). Instead—or in addition—should the size and shape of the maximum field determine whether the energy is used in reference to the distance between the transmitting unit and any receiving unit(s)? What parameters should be used for such a consideration?

144. We further seek comment on what factors we should consider to ensure that the RF beam from the transmitting unit is closely concentrated at the receiving unit, such that RF energy along the path(s) does not exceed our limits for RF exposure to potential human bodies or create potential for harmful interference to other services. How should we evaluate compliance of wireless power transfer at-a-distance devices with potential movements of humans in the RF field and the potential for very close proximity of the receiving unit to humans?³⁸⁵ We believe that these devices should comply with our rules under all operating conditions, including movements of people around and in the field. Should we propose to establish frequency bands and power limits specifically for wireless power transfer at-a-distance devices either under Part 15 or Part 18 of our rules, including operation in designated ISM bands (instead of allowing unlimited power in these bands, as Part 18 currently permits)?³⁸⁶ If we do establish power limits, what should be the basis for such limits and should there be any consideration for potential harmful interference to other non-part 18 devices given the popularity of these frequency bands for consumer devices?³⁸⁷ With respect to the potential for harmful interference from wireless power transfer devices to active medical devices that may be worn or implanted (e.g., body worn insulin pumps, implantable cardiac pacemakers, implantable deep brain stimulators (DBS), spinal cord stimulators), what mitigation techniques should be required?³⁸⁸

145. Finally, we seek input on the following issues:³⁸⁹ Under what category of spectrum use should we consider wireless power transfer, e.g., either ISM under Part 18, Part 15, or new rule part? What radio frequency bands are most suitable for wireless power transfer?³⁹⁰ What steps are required to

³⁸⁵ We expect that there may be devices intended to charge a cellphone while in a pocket, and as the owner moves around in a room.

³⁸⁶ CISPR 28:1997, Technical Report, *Industrial, scientific and medical equipment (ISM) – Guidelines for emission levels within the bands designated by the ITU*, (1997).

³⁸⁷ For example, Wi-Fi devices operate under 47 CFR § 15.247 in the 2400–2483.5 GHz band, which is also an ISM band.

³⁸⁸ See Letter from Jeffrey Shuren, M.D., J.D., Director, Center for Devices and Radiological Health, Food and Drug Administration, Department of Health and Human Services, to Julius Knapp, FCC, (dated April 24, 2019) (*FDA Letter*) at 2 (suggesting that “the most effective mitigation against EMI to active medical devices from the emissions of WPT devices is to reduce the WPT emissions and thus medical device exposure. The methods to reduce exposure should include limits on the WPT output power, designing the WPT with safety interlocks (i.e., designing the WPT source so that it can detect the presence of humans or animals and shut off or greatly reduce power output), creating exclusion zones, and recommending separation distances between the WPT emitter and any active medical devices.”)

³⁸⁹ These issues are also being considered in the International Telecommunications Union (ITU) Radio Communication Study Group 1, ITU-R 210 3/1, <http://www.itu.int/pub/R-QUE-SG01.210>.

³⁹⁰ We note that Toyota Motor North America, Inc., Ford Motor Company, BMW of North America LLC, and Nissan North America, Inc. (Toyota et al.) has submitted a joint Petition for Rule Making, requesting to operate WPT charging for light-duty electric vehicles in the 79-90 kHz frequency band, at emission limits higher than what Part 18 is allowing in this band. See Toyota et al., Petition for Rule Making for Amendment of the Commission’s Rules to Allow Next-Generation Wireless Charging Technology for Electric Vehicles Under Part 18 (filed Sept. 5, 2018), RM-11815, <https://www.fcc.gov/edocs/search-results?t=advanced&dockets=11815>. We note that the petition received several supporting comments; with one opposition from ARRL (stating that “the precise subject of this Petition is in the early stages of international study and evaluation, and the soonest that the subject will be addressed internationally on any comprehensive level is at the 2019 World Radiocommunication Conference (“WRC-19”)”).

ensure that radiocommunication services, including the radio astronomy service, as well as active medical devices, as indicated above, are protected from wireless power transfer operations?

146. *Certification.* Under Part 18, wireless power transfer equipment is currently authorized pursuant to the Supplier's Declaration of Conformity (SDoC)³⁹¹ rules (formerly the Declaration of Conformity rules), with the option to use the Certification³⁹² rules.³⁹³

147. Because of the continuing evolution of wireless power transfer technology, and the potential use at higher power and in closer proximity to humans, we propose to require wireless power transfer equipment for both consumer and non-consumer applications to be subject to our Certification rules.³⁹⁴ Certification will allow the Commission to ensure that the devices comply with our RF exposure rules which may be achieved by determining whether either an RF exposure exemption applies or a routine RF exposure evaluation is required.³⁹⁵ The FCC Laboratory presently provides guidance that requires applicants for authorization of wireless power transfer devices to consult with the FCC Laboratory on measurement procedures prior to equipment authorization, but exempts certain low-power wireless power transfer devices from this requirement.³⁹⁶ These low-power wireless power transfer devices include those that operate on frequencies below 1 MHz, at power levels less than 15 watts, only in mobile device exposure condition (> 20 cm from the body), and only use single primary and secondary coils in close proximity. We seek comment on whether we should adopt a rule to exempt such low-power wireless power transfer devices from requiring certification and instead allow them to continue to be authorized using our SDoC procedure. In addition, are there other criteria we should consider when exempting wireless power transfer devices from the certification requirement, if so, what are they and why?

³⁹¹ Supplier's Declaration of Conformity (SDoC) is a procedure that requires the party responsible for compliance ensure that the equipment complies with the appropriate technical standards. *See* 47 CFR § 2.906. The responsible party, who must be located in the United States, is not required to file an equipment authorization application with the Commission or a Telecommunication Certification Body (TCB). *See* 47 CFR § 2.909. Equipment authorized under the SDoC procedure is not listed in a Commission database. However, the responsible party or any other party marketing the equipment must provide a test report and other information demonstrating compliance with the rules upon request by the Commission. *See* 47 CFR § 2.938. The responsible party has the option to use the certification procedure in place of the SDoC procedure. *See* 47 CFR § 2.906(c).

³⁹² Certification is the most rigorous approval process for RF devices that have the greatest potential to cause harmful interference to radio services. It is an equipment authorization issued by an FCC-recognized TCB based on an evaluation of the supporting documentation and test data submitted by the responsible party (e.g., the manufacturer or importer) to the TCB. *See* 47 CFR § 2.907. Testing is performed by an FCC-recognized accredited testing laboratory. *See* 47 CFR § 2.948. Information including the technical parameters and descriptive information for all certified equipment is posted on a Commission-maintained public database. In addition, equipment subject to approval using the SDoC procedure can optionally use the Certification procedure. *See* 47 CFR § 2.906(c).

³⁹³ *See* 47 CFR § 18.203.

³⁹⁴ *See* 47 CFR pt. 2, Subpart J.

³⁹⁵ *See* 47 CFR §§ 2.1091 & 2.1093. The Commission maintains a database of all RF equipment certified by the Commission and TCBs. This database allows the Commission to verify that a device is approved without having to contact the TCB or the manufacturer to obtain the records demonstrating compliance with the FCC requirements. The database also provides a single publicly available source of information that parties can use to verify approvals and obtain copies of applications for and grants of certification. *See* <http://www.fcc.gov/oet/ea/>.

³⁹⁶ KDB Publication 680106.

VI. MEMORANDUM OPINION AND ORDER

148. Lastly, in this *Memorandum Opinion and Order*, we address a petition for reconsideration (*Petition*) filed by the American Association for Justice (AAJ).³⁹⁷ AAJ seeks reconsideration of a portion of the Commission's 2013 *RF Order and Notice* relating to the classification of the pinnae (outer ears) as extremities for purposes of testing compliance with our RF emission limits for human exposure.³⁹⁸ In the 2013 *RF Order and Notice*, the Commission adopted rules classifying the pinnae in the same manner as other bodily extremities³⁹⁹ for purposes of evaluating localized specific absorption rates (SAR).⁴⁰⁰ On July 1, 2013, AAJ submitted its *Petition* objecting to this change. Oppositions to the *Petition* were filed by four parties.⁴⁰¹

149. Pursuant to the Commission's rules, any interested person may petition for reconsideration of a final action in a rulemaking proceeding.⁴⁰² Reconsideration may be denied where a petitioner fails to present facts and arguments unconsidered by the Commission⁴⁰³ or in an action by a Bureau or Office where the petitioner fails to identify a material error or omission in the original order, raises additional facts or arguments not known or not existing until after the petitioner's last opportunity to respond, or relies on arguments that have been fully considered and rejected by the Commission within the same proceeding.⁴⁰⁴ As discussed below, the AAJ petition for reconsideration does not raise new facts or arguments, nor does it demonstrate any errors or omissions in the Commission's previous decision.⁴⁰⁵ Furthermore, while the relevant docket, ET No. 03-137, had been open since 2003, AAJ presented its petition and accompanying arguments following the adoption of the 2013 *RF Order and Notice*. In its

³⁹⁷ Petition of the American Association for Justice for Reconsideration of Pinna Classification, ET Docket No. 03-137 (filed on July 1, 2013), <https://www.fcc.gov/ecfs/filing/6017456259/document/7520927003> (*Petition*).

³⁹⁸ *Id.* at 2.

³⁹⁹ "Extremities" is a non-technical term that is only used to collectively identify certain body parts distinguished from the whole body for purposes of allowable peak spatial-average SAR limits. In addition to the pinnae, hands, wrists, feet, and ankles are considered "extremities." 47 CFR § 1.1310(b).

⁴⁰⁰ See *Order*, Section III.A.3., Pinna (Outer Ear) Classification as an Extremity, 28 FCC Rcd 3514-3517, para. 42-50 (2013).

⁴⁰¹ Opposition to Petition for Reconsideration from James Edwin Whedbee, ET Docket No. 03-137, at 4 (filed July 1, 2013), <https://www.fcc.gov/ecfs/filing/6017456364/document/7520927134>; Opposition to Petition for Reconsideration from CTIA – The Wireless Association, ET Docket No. 03-137, at 3 (filed September 11, 2013) <https://www.fcc.gov/ecfs/filing/6017466697/document/7520942994>; Opposition to Petition for Reconsideration from Telecommunications Industry Association, ET Docket No. 03-137, at 2 (filed September 11, 2013) <https://www.fcc.gov/ecfs/filing/6017466679/document/7520942974>; Opposition to Petition for Reconsideration from Mobile Manufacturers Forum, ET Docket No. 03-137, at 3 (filed September 10, 2013) <https://www.fcc.gov/ecfs/filing/6017466542/document/7520942819>. Inasmuch as our rejection of the *Petition* is consistent with the position of these opposition pleadings, we forego any further discussion of them here.

⁴⁰² 47 CFR § 1.429(a); see 47 U.S.C. § 405(a) (stating that "[a]fter an order, decision, report, or action has been made or taken in any proceeding by the Commission . . . , any party thereto, or any other person aggrieved or whose interests are adversely affected thereby, may petition for reconsideration").

⁴⁰³ See 47 C.F.R. § 1.429(b).

⁴⁰⁴ See 47 C.F.R. § 1.429(l).

⁴⁰⁵ Moreover, AAJ couches its argument in terms of the "consideration of costs" standard of review set forth in *Chamber of Commerce v. SEC*, 412 F.3d 133, 142-43 (D.C. Cir. 2005), and argues that cost-benefit analysis indicates that the FCC does not possess the adequate authority to promulgate its Order and the proposed reclassification of the pinnae. This case is irrelevant to our consideration. The "consideration of costs" standard (1) is based on the specific statutory language of the Investment Company Act of 1940, which regulates funds that engage primarily in investing, reinvesting, and trading in securities; and (2) applies only to rulemaking actions by the SEC. See 15 U.S.C. § 80a-2(c).

petition for reconsideration, AAJ did not present facts and arguments that it could not have presented much earlier by exercise of ordinary diligence. Since AAJ's petition for reconsideration does not meet the regulatory requirements for being granted, we dismiss and, in the alternative, deny it.

150. AAJ argues that treating the pinnae as extremities is likely to lead to greater exposure to the head, which it contends is a health risk.⁴⁰⁶ It devotes much of its *Petition* to discussing potential health risks to children and adults, arguing that there is a nexus between RF exposure to the pinnae and adverse health effects due to its proximity to the brain.⁴⁰⁷ The *Petition* also includes general statements concerning the increasing use of cell phones, challenges Commission reliance on data from "an organization populated by industry insiders" [the IEEE], and exhorts the Commission to review recent RF cancer epidemiology.⁴⁰⁸ It specifically argues that the Commission should "re-examine the standards limiting radiofrequency (RF) energy emitted by cell phones [and] ... ameliorate uncertainty surrounding human exposure to RF radiation."⁴⁰⁹ The AAJ concludes its *Petition* by urging the FCC to commit to a more robust exploration into the area of health and RF exposure.⁴¹⁰

151. We agree that examining the continued propriety of our RF exposure standards has been appropriate; indeed, such an examination was undertaken and was underway even as AAJ filed its petition.⁴¹¹ However, the *2013 RF Order and Notice* discussed in detail how the pinnae have similar anatomical tissue compositions and thermal tolerances to other extremities and why these similarities warranted the pinnae's classification as extremities,⁴¹² and AAJ has not substantively disputed this reasoning.

152. AAJ's *Petition* contains no new information or arguments that specifically address the effects of RF exposure on the pinnae themselves and otherwise relies on arguments that have been fully considered and rejected. While the AAJ suggests that the pinnae are fundamentally different from other extremities due to its proximity to the brain, the AAJ has not demonstrated scientifically or quantitatively why that proximity is material for SAR limits that are based solely on localized thermal effects. Moreover, AAJ's arguments about the pinnae's proximity to the brain were addressed in the *2013 RF Order and Notice*.⁴¹³ Classifying the pinnae as extremities did not change the fact that for the head, SAR limits were retained at the more stringent 1.6 W/kg, averaged over any one-gram cube of tissue.⁴¹⁴ Additionally, as we stated in our decision, before the pinnae's classification as extremities, standard evaluation procedures for SAR compliance did not measure or calculate RF exposure in the pinnae, but measured RF exposure *within* a test mannequin head.⁴¹⁵ The *2013 RF Order and Notice* noted that the pinnae classification "has no practical effect on human exposure," and that "devices that meet the localized SAR limits applicable to the head will typically meet the SAR limit for extremities with respect to the pinna[e]."⁴¹⁶ Furthermore, the AAJ does not offer the Commission previously unrepresented

⁴⁰⁶ *Petition* at 2.

⁴⁰⁷ *Petition* at 4.

⁴⁰⁸ *Petition* at 2.

⁴⁰⁹ *Petition* at 1.

⁴¹⁰ *Petition* at 8.

⁴¹¹ See *RF Order and Notice*, 28 FCC Rcd at 3570, para. 205.

⁴¹² See *id.* at 3515, para. 48.

⁴¹³ AAJ's petition relied on arguments that have been fully considered and rejected by the Commission within the same proceeding, rendering the petition procedurally defective and appropriate for dismissal. See 47 C.F.R. § 1.429(l)(3).

⁴¹⁴ See *RF Order and Notice*, 28 FCC Rcd at 3514, para. 44.

⁴¹⁵ *Id.* at 3516, para. 49.

⁴¹⁶ *Id.*

arguments when it cites alternative concerns related to pinnae classification, brain proximity, and human safety. The 2013 *RF Order and Notice* took note of a number of comments concerning possible “non-thermal” biological effects of RF and the brain, but rationally excluded considering these “non-thermal” effects when classifying the pinnae as extremities for SAR compliance, limiting the decision to the consideration of tissue composition and thermal properties only within the pinnae themselves, alongside the support of expert determinations of the FDA and of the IEEE, while deferring such other “non-thermal” considerations raised for consideration in our *Inquiry*.⁴¹⁷ In terminating our *Inquiry*, we have rigorously analyzed our existing RF exposure framework and have dismissed the notion that the existing framework should be altered on account of any “non-thermal” effects.⁴¹⁸

153. The AAJ offers no persuasive evidence that the Commission’s analysis is flawed. AAJ argues that analysis the Commission relied on from the IEEE analysis on pinnae classification is outdated merely because the C95.1 standard was adopted in 2006. It correctly states “mobile phone and wireless technology have undergone substantial changes” in the past decade.⁴¹⁹ Nowhere, however, does AAJ quantitatively specify how particular technological changes should affect SAR classifications for the pinnae. As recognized in the 2013 *RF Order and Notice*, the IEEE developed the only substantial record on the subject, and while AAJ claims (without substantiation) that IEEE is biased,⁴²⁰ that record has the current support of federal health and safety agencies, including the Food and Drug Administration (FDA) Center for Devices and Radiological Health.⁴²¹ While AAJ relies on studies and other information from the IARC and the National Cancer Institute, among others, the Commission recognizes that it is not a health and safety agency, and necessarily gives considerable weight to the expertise of agencies and groups, like the FDA and IEEE, who can interpret the biological research necessary to assess the health impact of RF emissions and determine what exposure levels can be considered safe for humans. Based on the record and the views of these expert agencies and groups, we find no merit in AAJ’s petition.

154. To conclude, both the *Petition*’s contents and the timeliness of its arguments do not warrant a grant. Accordingly, we dismiss and alternatively deny the petition for reconsideration.

VII. PROCEDURAL MATTERS

155. *Paperwork Reduction Analysis.* This *Second Report and Order* contains new information collection requirements. subject to the Paperwork Reduction Act of 1995 (PRA), Public Law 104-13. It will be submitted to the Office of Management and Budget (OMB) for review under Section 3507(d) of the PRA. OMB, the general public, and other Federal agencies are invited to comment on the new information collection requirements contained in this proceeding. In addition, we note that pursuant to the Small Business Paperwork Relief Act of 2002 (SBPRA), Public Law 107-198, see 44 U.S.C. 3506(c)(4), we previously sought specific comment on how the Commission might further reduce the information collection burden for small business concerns with fewer than 25 employees.

156. With regard to the *Second Report and Order*, we have assessed the effects of various changes and clarifications, and consistent with the previous review of how our proposals might impose

⁴¹⁷ *Id.* at 3515, para 46 & n.84, citing EMR Network comments, ET Docket No. 03-137, at 3-4, EMR Network reply comments at 1-2.

⁴¹⁸ See *Termination of Notice of Inquiry*, *supra* para. 10.

⁴¹⁹ *Petition* at 4.

⁴²⁰ AAJ did not present evidence that IEEE is biased. We reject this assertion and note that the IEEE (1) is the world's largest association of technical professionals; (2) has a diverse membership of 423,000 members in over 160 countries around the world, with members from a wide range of disciplines, and balanced representation from the medical, scientific, engineering, industrial, governmental, and other communities; (3) is composed of leading experts in the field of RF emissions with the roots of the organization having originally formed out of the [Institute of Radio Engineers](#); and (4) follows an open consensus process.

⁴²¹ See *RF Order and Notice*, 28 FCC Rcd. at 3514, para. 45 (2013).

information collection burdens on small business concerns, we anticipate no adverse impacts on small business concerns with fewer than 25 employees.

157. The Notice of Proposed Rulemaking also contains proposed information collection requirements. The Commission, as part of its continuing effort to reduce paperwork burdens, invites the general public and OMB to comment on the information collection requirements contained in this document, as required by the Paperwork Reduction Act of 1995, Public Law 104-13. In addition, pursuant to the Small Business Paperwork Relief Act of 2002, Public Law 107-198, *see* 44 U.S.C. § 3506(c)(4), we seek specific comment on how we might further reduce the information collection burden for small business concerns with fewer than 25 employees.

158. *Congressional Review Act.* The Commission will send a copy of this Second Report and Order to Congress and the Government Accountability Office pursuant to the Congressional Review Act, *see* 5 U.S.C. 801(a)(1)(A).

159. *Initial Regulatory Flexibility Analysis.* As required by the Regulatory Flexibility Act of 1980, as amended (RFA),⁴²² the Commission has prepared an Initial Regulatory Flexibility Analysis (IRFA) of the possible significant economic impact on a substantial number of small entities of the proposals addressed in this NPRM. The IRFA is set forth in Appendix C. Written public comments are requested on the IRFA. Comments must be identified as responses to the IRFA and must be filed by the deadlines for comments on the NPRM. The Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, will send a copy of the NPRM, including the IRFA, to the Chief Counsel for Advocacy of the Small Business Administration (SBA).⁴²³ In addition, the NPRM and IRFA (or summaries thereof) will be published in the Federal Register.⁴²⁴

160. *Final Regulatory Flexibility Analysis.* The Regulatory Flexibility Act (RFA) requires that an agency prepare a regulatory flexibility analysis for notice and comment rulemakings, unless the agency certifies that "the rule will not, if promulgated, have a significant economic impact on a substantial number of small entities." According, we have prepared Final Regulatory Flexibility Analysis concerning the possible impact of the Second Report and Order on small entities. The Final Regulatory Flexibility Analysis is set forth in Appendix D.

161. *Ex Parte Presentations.* All requests for meetings with Commission staff regarding these Dockets should be via email to Martin.Doczkat@FCC.Gov. Those who lack Internet access may direct their requests by phone to 202-418-2470.

162. This proceeding shall be treated as a "permit-but-disclose" proceeding in accordance with the Commission's *ex parte* rules.⁴²⁵ Persons making *ex parte* presentations must file a copy of any written presentation or a memorandum summarizing any oral presentation within two business days after the presentation (unless a different deadline applicable to the Sunshine period applies). Persons making oral *ex parte* presentations are reminded that memoranda summarizing the presentation must (1) list all persons attending or otherwise participating in the meeting at which the *ex parte* presentation was made, and (2) summarize all data presented and arguments made during the presentation. If the presentation consisted in whole or in part of the presentation of data or arguments already reflected in the presenter's written comments, memoranda or other filings in the proceeding, the presenter may provide citations to such data or arguments in his or her prior comments, memoranda, or other filings (specifying the relevant page and/or paragraph numbers where such data or arguments can be found) in lieu of summarizing them in the memorandum. Documents shown or given to Commission

⁴²² *See* 5 U.S.C. § 603.

⁴²³ *See* 5 U.S.C. § 603(a).

⁴²⁴ *See id.*

⁴²⁵ 47 CFR §§ 1.1200 *et seq.*

staff during *ex parte* meetings are deemed to be written *ex parte* presentations and must be filed consistent with rule 1.1206(b). In proceedings governed by rule 1.49(f) or for which the Commission has made available a method of electronic filing, written *ex parte* presentations and memoranda summarizing oral *ex parte* presentations, and all attachments thereto, must be filed through the electronic comment filing system available for that proceeding, and must be filed in their native format (e.g., .doc, .xml, .ppt, searchable .pdf). Participants in this proceeding should familiarize themselves with the Commission's *ex parte* rules.

163. *Comment Filing Procedures.* Pursuant to Sections 1.415 and 1.419, 47 CFR §§ 1.415, 1.419, interested parties may file comments and reply comments on or before the dates indicated on the first page of this document. Comments may be filed using the Commission's Electronic Comment Filing System (ECFS). See *Electronic Filing of Documents in Rulemaking Proceedings*, 63 FR 24121 (1998).

- *Electronic Filers.* Comments may be filed electronically using the Internet by accessing the ECFS, <http://apps.fcc.gov/ecfs>.
- *Paper Filers.* Parties who file by paper must include an original and four copies of each filing. If more than one docket or rulemaking number appears in the caption of this proceeding, filers must submit two additional copies for each additional docket or rulemaking number.

Filings can be sent by hand or messenger delivery, by commercial overnight courier, or by first-class or overnight U.S. Postal Service mail. All filings must be addressed to the Commission's Secretary, Office of the Secretary, Federal Communications Commission.

- All hand-delivered or messenger-delivered paper filings for the Commission's Secretary must be delivered to FCC Headquarters at 445 12th Street, SW., Room TW-A325, Washington, DC 20554. The filing hours are 8:00 a.m. to 7:00 p.m. All hand deliveries must be held together with rubber bands or fasteners. Any envelopes must be disposed of *before* entering the building.
- Commercial overnight mail (other than U.S. Postal Service Express Mail and Priority Mail) must be sent to 9050 Junction Drive, Annapolis Junction, MD 20701.
- U.S. Postal Service first-class, Express, and Priority mail must be addressed to 445 12th Street, SW, Washington DC 20554.
- *Persons with Disabilities.* To request materials in accessible formats for persons with disabilities (braille, large print, electronic files, audio format), send an email to fcc504@fcc.gov or call the Consumer & Governmental Affairs Bureau at 202-418-0530 (voice), 202-418-0432 (TTY).

164. *Further Information.* For further information about this Notice, please contact 202-418-2470.

VIII. ORDERING CLAUSES

165. Accordingly, IT IS ORDERED, that pursuant to Sections 1, 4(i), 4(j), 301, 302, 303(r), 307, 308, 309, 332(a)(1), 332(c)(7)(B)(iv), and 403 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 151, 154(i), 154(j), 301, 302a, 303(r), 307, 308, 309, 332(a)(1), 332(c)(7)(B)(iv), 403; the National Environmental Policy Act of 1969, 42 U.S.C. § 4321 *et seq.*; and Section 704(b) of the Telecommunications Act of 1996, Pub. L. No. 104-104, this *Second Report and Order* and *Notice of Proposed Rulemaking* **IS HEREBY ADOPTED**.

166. IT IS FURTHER ORDERED that the Commission's rules **ARE AMENDED** as set forth in Appendix A. These rule revisions in this *Second Report and Order* will become effective **[60 DAYS AFTER DATE OF PUBLICATION FEDERAL REGISTER]**, except for Section 2.1091(d)(3) of the rules, which contains information collection requirements subject to the Paperwork Reduction Act of 1995, Public Law 104-13, and will become effective after Office of Management and Budget (OMB)

review and approval, on the effective date specified in a notice that the Commission will publish in the Federal Register announcing such approval and effective date.

167. IT IS FURTHER ORDERED that pursuant to Section 405 of the Communications Act of 1934, as amended, 47 U.S.C. § 405, and Section 1.429 of the Commission's rules, 47 CFR § 1.429, this *Memorandum Opinion and Order* **IS HEREBY ADOPTED** and the Petition for Reconsideration filed by AAJ **IS DISMISSED AND ALTERNATIVELY DENIED**.

168. IT IS FURTHER ORDERED that pursuant to authority contained in contained in Sections 4(i) and 4(j) of the Communications Act of 1934, as amended, 47 U.S.C. Sections 154(i), 154(j) and Section 1.430 of the Commission's rules, 47 CFR Section 1.430, the *Inquiry*, ET Docket No. 13-84 **IS TERMINATED**.

169. IT IS FURTHER ORDERED that pursuant to authority contained in contained in Sections 4(i) and 4(j) of the Communications Act of 1934, as amended, 47 U.S.C. Sections 154(i), 154(j) and Section 1.430 of the Commission's rules, 47 CFR Section 1.430, ET Docket No. 03-137 **IS TERMINATED**.

170. IT IS FURTHER ORDERED, that the Commission's Consumer and Governmental Affairs Bureau, Reference Information Center **SHALL SEND** a copy of the *Second Report and Order*, including the Final Regulatory Flexibility Analysis, the Memorandum Opinion and Order, and the Notice of Proposed Rulemaking, including the Initial Regulatory Flexibility Analysis, to the Chief Counsel for Advocacy of the Small Business Administration.

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch
Secretary

APPENDIX A

Final Rules

The Federal Communications Commission amends title 47 of the Code of Federal Regulations, Parts 1, 2, 15, 18, 22, 24, 25, 27, 73, 90, 95, 97, and 101 as follows:

PART 1 – PRACTICE AND PROCEDURE

1. The authority citation for Part 1 continues to read as follows:

Authority: [INSERT CURRENT AUTHORITY CITATION].

2. Section 1.1307 is amended by revising paragraph (b) to read as follows:

§ 1.1307 Actions that may have a significant environmental effect, for which Environmental Assessments (EA) must be prepared.

* * * * *

(b)(1) With respect to the limits on human exposure to RF provided in Section 1.1310 of this chapter, applicants to the Commission for the grant or modification of construction permits, licenses or renewals thereof, temporary authorities, equipment authorizations, or any other authorizations for radiofrequency sources must either: (i) determine that they qualify for an exemption pursuant to Section 1.1307(b)(3); (ii) prepare an evaluation of the human exposure to RF radiation pursuant to Section 1.1310 and include in the application a statement confirming compliance with the limits in Section 1.1310; or (iii) prepare an Environmental Assessment if those RF sources would cause human exposure to levels of RF radiation in excess of the limits in Section 1.1310. Compliance with these limits for fixed RF source(s) may be accomplished by use of mitigation actions, as provided in Section 1.1307(b)(4). Upon request by the Commission, the party seeking or holding such authorization must submit technical information showing the basis for such compliance, either by exemption or evaluation. Notwithstanding the preceding requirements, in the event that RF sources cause human exposure to levels of RF radiation in excess of the limits in Section 1.1310 of this chapter, such RF exposure exemptions and evaluations are not deemed sufficient to show that there is no significant effect on the quality of the human environment or that the RF sources are categorically excluded from environmental processing.

(2) *Definitions.* For the purposes of this Section, the following definitions shall apply.

Available maximum time-averaged power for an RF source is the maximum available RF power (into a matched load) as averaged over a *time-averaging period*;

Category One is any spatial region that is compliant with the general population exposure limit with *continuous exposure* or *source-based time-averaged exposure*;

Category Two is any spatial region where the general population exposure limit is exceeded but that is compliant with the occupational exposure limit with *continuous exposure*;

Category Three is any spatial region where the occupational exposure limit is exceeded but by no more than ten times the limit;

Category Four is any spatial region where the exposure is more than ten times the occupational exposure limit or where there is a possibility for serious injury on contact.

Continuous exposure refers to the maximum time-averaged exposure at a given location for an *RF source* and assumes that exposure may take place indefinitely. The exposure limits in Section 1.1310 of this chapter are used to establish the spatial regions where mitigation measures are necessary assuming continuous exposure as prescribed in Section 1.1307(b)(4) of this chapter.

Effective Radiated Power (ERP) is the product of the *maximum antenna gain* which is the largest far-field power gain relative to a dipole in any direction for each transverse polarization component, and the *maximum delivered time-averaged power* which is the largest net power delivered or supplied to an antenna as averaged over a *time-averaging period*; *ERP* is summed over two polarizations when present;

Exemption for (an) *RF source(s)* is solely from the obligation to perform a routine environmental evaluation to demonstrate compliance with the RF exposure limits in Section 1.1310 of this chapter; it is not exemption from the equipment authorization procedures described in Part 2 of this chapter, not exemption from general obligations of compliance with the RF exposure limits in Section 1.1310 of this chapter, and not exemption from determination of whether there is no significant effect on the quality of the human environment under Section 1.1306 of this chapter.

Fixed RF source is one that is physically secured at one location, even temporarily, and is not able to be easily moved to another location while radiating;

Mobile device is as defined in Section 2.1091(b) of this chapter;

Plane-wave equivalent power density is the square of the root-mean-square (rms) electric field strength divided by the impedance of free space (377 ohms).

Portable device is as defined in Section 2.1093(b) of this chapter;

Positive access control is mitigation by proactive preclusion of unauthorized access to the region surrounding an RF source where the continuous exposure limit for the general population is exceeded. Examples of such controls include locked doors, ladder cages, or effective fences, as well as enforced prohibition of public access to external surfaces of buildings. However, it does not include natural barriers or other access restrictions that did not require any action on the part of the licensee or property management.

Radiating structure is an unshielded RF current-carrying conductor that generates an RF reactive near electric or magnetic field and/or radiates an RF electromagnetic wave. It is the component of an *RF source* that transmits, generates, or reradiates an RF fields, such as an antenna, aperture, coil, or plate.

RF source is Commission-regulated equipment that transmits or generates RF fields or waves, whether intentionally or unintentionally, via one or more *radiating structure(s)*. Multiple *RF sources* may exist in a single device.

Separation distance (variable R in Table 1) is the minimum distance in any direction from any part of a *radiating structure* and any part of the body of a nearby person;

Source-based time averaging is an average of instantaneous exposure over a *time-averaging period* that is based on an inherent property or duty-cycle of a device to ensure compliance with the *continuous exposure* limits;

Time-averaging period is a time period not to exceed 30 minutes for fixed RF sources or a time period inherent from device transmission characteristics not to exceed 30 minutes for mobile and portable RF

sources;

Transient individual is an untrained person in a location where occupational/controlled limits apply, and he or she must be made aware of the potential for exposure and be supervised by trained personnel pursuant to Section 1.1307(b)(4) of this chapter where use of time averaging is required to ensure compliance with the general population exposure limits in Section 1.1310 of this chapter.

(3) Determination of exemption.

(i) For single RF sources (*i.e.*, any single fixed RF source, mobile device, or portable device, as defined in Section 1.1307(b)(2) of this chapter): A single RF source is exempt if:

(A) the available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in Section 1.1307(b)(3)(ii)(A). Medical implant devices may only use this exemption and that in Section 1.1307(b)(3)(ii)(A);

(B) or the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by:

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20cm} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20cm} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$$

Where

$$x = -\log_{10} \left(\frac{60}{ERP_{20cm} \sqrt{f}} \right) \text{ and } f \text{ is in GHz}$$

and

$$ERP_{20cm} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

d = the separation distance (cm);

(C) or using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

Table 1—Single RF Sources Subject to Routine Environmental Evaluation

RF Source Frequency (MHz)	Threshold ERP (watts)
0.3 – 1.34	1,920 R ²
1.34 – 30	3,450 R ² /f ²
30 – 300	3.83 R ²
300 – 1,500	0.0128 R ² f
1,500 – 100,000	19.2R ²

(ii) For multiple RF sources. Multiple RF sources are exempt if:

(A) the available maximum time-averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required). This exemption may not be used in conjunction with other exemption criteria other than those in Section 1.1307(b)(3)(i)(A). Medical implant devices may only use this exemption and that in Section 1.1307(b)(3)(i)(A).

(B) in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation.

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$$

Where

- a = number of fixed, mobile, or portable RF sources claiming exemption using paragraph (b)(3)(i)(B) of this section for P_{th} , including existing exempt transmitters and those being added.
- b = number of fixed, mobile, or portable RF sources claiming exemption using paragraph (b)(3)(i)(C) of this section for Threshold ERP, including existing exempt transmitters and those being added.
- c = number of existing fixed, mobile, or portable RF sources with known evaluation for the specified minimum distance including existing evaluated transmitters.
- P_i = the available maximum time-averaged power or the ERP, whichever is greater, for fixed, mobile, or portable RF source i at a distance between 0.5 cm and 40 cm (inclusive).
- $P_{th,i}$ = the exemption threshold power (P_{th}) according to paragraph (b)(3)(i)(B) of this section for fixed, mobile, or portable RF source i .
- ERP_j = the ERP of fixed, mobile, or portable RF source j .
- $ERP_{th,j}$ = exemption threshold ERP for fixed, mobile, or portable RF source j , at a distance of at least $\lambda/2\pi$ according to the applicable formula of paragraph (b)(3)(i)(C) of this section.
- $Evaluated_k$ = the maximum reported SAR or MPE of fixed, mobile, or portable RF source k either in the

device or at the transmitter site from an existing evaluation at the location of exposure.

Exposure Limit_k = either the general population/uncontrolled maximum permissible exposure (MPE) or specific absorption rate (SAR) limit for each fixed, mobile, or portable RF source *k*, as applicable from Section 1.1310 of this chapter.

(4) Mitigation. (i) As provided in the following paragraphs, specific mitigation actions are required for fixed RF sources to the extent necessary to ensure compliance with our exposure limits, including the implementation of an RF safety plan, restriction of access to those RF sources, and disclosure of spatial regions where exposure limits are exceeded.

(ii) Category One – INFORMATION: No mitigation actions are required when the RF source does not cause continuous or source-based time-averaged exposure in excess of the general population limit in Section 1.1310 of this chapter. Optionally a green “INFORMATION” sign may offer information to those persons who might be approaching RF sources. This optional sign, when used, must include at least the following information: appropriate signal word “INFORMATION” and associated color (green), an explanation of the safety precautions to be observed when closer to the antenna than the information sign, a reminder to obey all postings and boundaries (if higher categories are nearby), up-to-date licensee (or operator) contact information (if higher categories are nearby), and a place to get additional information (such as a website, if no higher categories are nearby).

(iii) Category Two – NOTICE: Mitigation actions are required in the form of signs and positive access control surrounding the boundary where the continuous exposure limit is exceeded for the general population, with the appropriate signal word “NOTICE” and associated color (blue) on the signs. Signs must contain the components discussed in paragraph (b)(4)(vi) of this section. Under certain controlled conditions, such as on a rooftop with limited access, a sign attached directly to the surface of an antenna will be considered sufficient if the sign specifies a minimum approach distance and is readable at this separation distance and at locations required for compliance with the general population exposure limit in Section 1.1310 of this chapter. Appropriate training is required for any occupational personnel with access to controlled areas within restrictive barriers where the general population exposure limit is exceeded, and transient individuals must be supervised by trained occupational personnel upon entering any of these areas. Use of time averaging is required for transient individuals to ensure compliance with the general population exposure limit.

(iv) Category Three – CAUTION: Signs (with the appropriate signal word “CAUTION” and associated color (yellow) on the signs), controls, or indicators (e.g., chains, railings, contrasting paint, diagrams) are required (in addition to the positive access control established for Category Two) surrounding the area in which the exposure limit for occupational personnel in a controlled environment is exceeded by no more than a factor of ten. Signs must contain the components discussed in paragraph (b)(4)(vi) of this section. If the boundaries between Category Two and Three are such that placement of both Category Two and Three signs would be in the same location, then the Category Two sign is optional. Under certain controlled conditions, such as on a rooftop with limited access, a sign may be attached directly to the surface of an antenna within a controlled environment if it specifies the minimum approach distance and is readable at this distance and at locations required for compliance with the occupational exposure limit in Section 1.1310 of this chapter. If signs are not used at the occupational exposure limit boundary, controls or indicators (e.g., chains, railings, contrasting paint, diagrams, etc.) must designate the boundary where the occupational exposure limit is exceeded. Additionally, appropriate training is required for any occupational personnel with access to the controlled area where the general population exposure limit is exceeded, and transient individuals must be supervised by trained personnel upon entering any of these areas. Use of time averaging is required for transient individuals to ensure compliance with the general population exposure limit. Further mitigation by reducing exposure time in accord with six-minute time averaging is required for occupational personnel in the area in which the occupational exposure limit is

exceeded. However, proper use of RF personal protective equipment may be considered sufficient in lieu of time averaging for occupational personnel in the areas in which the occupational exposure limit is exceeded. If such procedures or power reduction, and therefore Category reduction, are not feasible, then lockout/tagout procedures in 29 CFR Section 1910.147 must be followed.

(v) Category Four – WARNING/DANGER: Where the occupational limit could be exceeded by a factor of more than ten, “WARNING” signs with the associated color (orange), controls, or indicators (*e.g.*, chains, railings, contrasting paint, diagrams) are required (in addition to the positive access control established for Category Two) surrounding the area in which the occupational exposure limit in a controlled environment is exceeded by more than a factor of ten. Signs must contain the components discussed in paragraph (b)(4)(vi) of this section. “DANGER” signs with the associated color (red) are required where immediate and serious injury will occur on contact, in addition to positive access control, regardless of mitigation actions taken in Categories Two or Three. If the boundaries between Category Three and Four are such that placement of both Category Three and Four signs would be in the same location, then the Category Three sign is optional. No access is permitted without Category reduction. If power reduction, and therefore Category reduction, is not feasible, then lockout/tagout procedures in 29 CFR Section 1910.147 must be followed.

(vi) RF exposure advisory signs must be viewable and readable from the boundary where the applicable exposure limits are exceeded, pursuant to 29 CFR Section 1910.145, and include at least the following five components:

(A) Appropriate signal word, associated color (*i.e.*, “DANGER” (red), “WARNING” (orange), “CAUTION,” (yellow) “NOTICE” (blue));

(B) RF energy advisory symbol);

(C) An explanation of the RF source;

(D) Behavior necessary to comply with the exposure limits; and

(E) Up-to-date contact information.

(5)(i) In general, when the exposure limits specified in Section 1.1310 are exceeded in an accessible area due to the emissions from multiple fixed RF sources, actions necessary to bring the area into compliance or preparation of an Environmental Assessment (EA) as specified in Section 1.1311 are the shared responsibility of all licensees whose RF sources produce, at the area in question, levels that exceed 5% of the applicable exposure limit proportional to power. However, a licensee demonstrating that its facility was not the most recently modified or newly-constructed facility at the site establishes a rebuttable presumption that such licensee should not be liable in an enforcement proceeding relating to the period of non-compliance. Field strengths must be squared to be proportional to SAR or power density. Specifically, these compliance requirements apply if the square of the electric or magnetic field strength exposure level applicable to a particular RF source exceeds 5% of the square of the electric or magnetic field strength limit at the area in question where the levels due to multiple fixed RF sources exceed the exposure limit. Site owners and managers are expected to allow applicants and licensees to take reasonable steps to comply with the requirements contained in Section 1.1307(b)(1) and, where feasible, should encourage co-location of RF sources and common solutions for controlling access to areas where the RF exposure limits contained in Section 1.1310 might be exceeded. Applicants and licensees are required to share technical information necessary to ensure joint compliance with the exposure limits, including informing other licensees at a site in question of evaluations indicating possible non-compliance with the exposure limits.

(ii) Applicants for proposed RF sources that would cause non-compliance with the limits specified in Section 1.1310 at an accessible area previously in compliance must submit an EA if emissions from the applicant's RF source would produce, at the area in question, levels that exceed 5% of the applicable exposure limit. Field strengths must be squared if necessary to be proportional to SAR or power density.

(iii) Renewal applicants whose RF sources would cause non-compliance with the limits specified in Section 1.1310 at an accessible area previously in compliance must submit an EA if emissions from the applicant's RF source would produce, at the area in question, levels that exceed 5% of the applicable exposure limit. Field strengths must be squared if necessary to be proportional to SAR or power density.

* * * * *

3. Section 1.1310 is revised to read as follows:

§ 1.1310 Radiofrequency radiation exposure limits.

(a) Specific absorption rate (SAR) shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Section 1.1307(b) within the frequency range of 100 kHz to 6 GHz (inclusive).

(b) The SAR limits for occupational/controlled exposure are 0.4 W/kg, as averaged over the whole body, and a peak spatial-average SAR of 8 W/kg, averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the parts of the human body treated as extremities, such as hands, wrists, feet, ankles, and pinnae, where the peak spatial-average SAR limit for occupational/controlled exposure is 20 W/kg, averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). Exposure may be averaged over a time period not to exceed 6 minutes to determine compliance with occupational/controlled SAR limits.

(c) The SAR limits for general population/uncontrolled exposure are 0.08 W/kg, as averaged over the whole body, and a peak spatial-average SAR of 1.6 W/kg, averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the parts of the human body treated as extremities, such as hands, wrists, feet, ankles, and pinnae, where the peak spatial-average SAR limit is 4 W/kg, averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). Exposure may be averaged over a time period not to exceed 30 minutes to determine compliance with general population/uncontrolled SAR limits.

(d)(1) Evaluation with respect to the SAR limits in this section must demonstrate compliance with both the whole-body and peak spatial-average limits using technically supported measurement or computational methods and exposure conditions in advance of authorization (licensing or equipment certification) and in a manner that facilitates independent assessment and, if appropriate, enforcement. Numerical computation of SAR must be supported by adequate documentation showing that the numerical method as implemented in the computational software has been fully validated; in addition, the equipment under test and exposure conditions must be modeled according to protocols established by FCC-accepted numerical computation standards or available FCC procedures for the specific computational method.

(2) For operations within the frequency range of 300 kHz and 6 GHz (inclusive), the limits for maximum permissible exposure (MPE), derived from whole-body SAR limits and listed in Table 1 of paragraph (e)(1) of this section, may be used instead of whole-body SAR limits as set forth in paragraph (a) through (c) of this section to evaluate the environmental impact of human exposure to RF radiation as specified in Section 1.1307(b), except for portable devices as defined in Section 2.1093 as these evaluations shall be performed according to the SAR provisions in Section 2.1093 of this chapter.

(3) At operating frequencies above 6 GHz, the MPE limits listed in Table 1 of paragraph (e)(1) of this section shall be used in all cases to evaluate the environmental impact of human exposure to RF radiation as specified in Section 1.1307(b).

(4) Both the MPE limits listed in Table 1 of paragraph (e)(1) of this section and the SAR limits as set forth in paragraph (a) through (c) of this section are for continuous exposure, that is, for indefinite time periods. Exposure levels higher than the limits are permitted for shorter exposure times, as long as the average exposure over a period not more than the specified averaging time in Table 1 is less than (or equal to) the exposure limits. Detailed information on our policies regarding procedures for evaluating compliance with all of these exposure limits can be found in the most recent edition of FCC's *OET Bulletin 65*, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields," and its supplements, all available at the FCC's Internet Web site:

<https://www.fcc.gov/general/oet-bulletins-line>, and in the Office of Engineering and Technology (OET) Laboratory Division Knowledge Database (KDB) (<https://www.fcc.gov/kdb>).

Note to Paragraphs (a) through (d): SAR is a measure of the rate of energy absorption due to exposure to RF electromagnetic energy. These SAR limits to be used for evaluation are based generally on criteria published by the American National Standards Institute (ANSI) for localized SAR in Section 4.2 of "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," ANSI/IEEE Std C95.1-1992, copyright 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," NCRP Report No. 86, Section 17.4.5, copyright 1986 by NCRP, Bethesda, Maryland 20814. Limits for whole body SAR and peak spatial-average SAR are based on recommendations made in both of these documents. The MPE limits in Table 1 are based generally on criteria published by the NCRP in "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," NCRP Report No. 86, Sections 17.4.1, 17.4.1.1, 17.4.2 and 17.4.3, copyright 1986 by NCRP, Bethesda, Maryland 20814. In the frequency range from 100 MHz to 1500 MHz, these MPE exposure limits for field strength and power density are also generally based on criteria recommended by the ANSI in Section 4.1 of "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," ANSI/IEEE Std C95.1-1992, copyright 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017.

(e)(1) Table 1 sets forth limits for Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic fields.

Table 1—Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3–3.0	614	1.63	*(100)	≤ 6
3.0–30	1842/f	4.89/f	*(900/f ²)	< 6
30–300	61.4	0.163	1.0	< 6
300–1500			f/300	< 6
1500–100,000			5	< 6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	< 30

1.34–30	824/f	2.19/f	*(180/f ²)	< 30
30–300	27.5	0.073	0.2	< 30
300–1500			f/1500	< 30
1500–100,000			1.0	< 30

f = frequency in MHz

* = Plane-wave equivalent power density

(2) Occupational/controlled exposure limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. The phrase *fully aware* in the context of applying these exposure limits means that an exposed person has received written and/or verbal information fully explaining the potential for RF exposure resulting from his or her employment. With the exception of *transient* persons, this phrase also means that an exposed person has received appropriate training regarding work practices relating to controlling or mitigating his or her exposure. In situations when an untrained person is transient through a location where occupational/controlled limits apply, he or she must be made aware of the potential for exposure and be supervised by trained personnel pursuant to Section 1.1307(b)(2) of this chapter where use of time averaging is required to ensure compliance with the general population exposure limit. The phrase *exercise control* means that an exposed person is allowed and also knows how to reduce or avoid exposure by administrative or engineering work practices, such as use of personal protective equipment or time averaging of exposure.

(3) General population/uncontrolled exposure limits apply in situations in which the general public may be exposed, or in which persons who are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure. For example, RF sources intended for consumer use shall be subject to the limits for general population/uncontrolled exposure in this section.

(4) * * *

* * * * *

4. Section 1.4000 [Amended]

In Section 1.4000, remove and reserve paragraph (c).

PART 2 – FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS

5. The authority citation for Part 2 continues to read as follows:

Authority: [INSERT CURRENT AUTHORITY CITATION].

6. Section 2.1033 is amended by adding paragraph (f) to read as follows:

* * * * *

(f) Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in Sections 1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of modular transmitters under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

* * * * *

7. Section 2.1091 is amended by revising paragraphs (b), (c), (d)(1), and (d)(2) to read as follows:

§ 2.1091 Radiofrequency radiation exposure evaluation: mobile devices.

* * * * *

(b) For purposes of this Section, the definitions in Section 1.1307(b)(2) of this chapter shall apply. A mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the RF source's radiating structure(s) and the body of the user or nearby persons. In this context, the term “fixed location” means that the device is physically secured at one location and is not able to be easily moved to another location while transmitting. Transmitting devices designed to be used by consumers or workers that can be easily re-located, such as wireless devices associated with a personal desktop computer, are considered to be mobile devices if they meet the 20-centimeter separation requirement.

(c)(1) Evaluation of compliance with the exposure limits in Section 1.1310 of this chapter, and preparation of an EA if the limits are exceeded, is necessary for mobile devices with single RF sources having either more than an available maximum time-averaged power of 1 mW or more than the ERP listed in Table 1 of Section 1.1307(b)(3)(i)(C), whichever is greater. For mobile devices not exempt by Section 1.1307(b)(3)(i)(C) at distances from 20 centimeters to 40 centimeters and frequencies from 0.3 GHz to 6 GHz, evaluation of compliance with the exposure limits in Section 1.1310 of this chapter is necessary if the ERP of the device is greater than ERP_{20cm} in the formula below. If the ERP of a single RF source at distances from 20 centimeters to 40 centimeters and frequencies from 0.3 GHz to 6 GHz is not easily obtained, then the available maximum time-averaged power may be used (*i.e.*, without consideration of ERP) in comparison with the following formula only if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

$$P_{\text{m}}(\text{mW}) = ERP_{20\text{cm}}(\text{mW}) = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f < 6 \text{ GHz} \end{cases}$$

(2) For multiple mobile or portable RF sources within a device operating in the same time averaging period, routine environmental evaluation is required if the formula in Section 1.1307(b)(3)(ii)(B) of this chapter is applied to determine the exemption ratio and the result is greater than 1.

(3) Unless otherwise specified in this chapter, any other single mobile or multiple mobile and portable RF source(s) associated with a device is exempt from routine environmental evaluation for RF exposure prior to equipment authorization or use, except as specified in Sections 1.1307(c) and 1.1307(d) of this chapter.

(d)(1) Applications for equipment authorization of mobile RF sources subject to routine environmental evaluation must contain a statement confirming compliance with the limits specified in Section 1.1310 of this chapter as part of their application. Technical information showing the basis for this statement must be submitted to the Commission upon request. In general, maximum time-averaged power levels must be used for evaluation. All unlicensed personal communications service (PCS) devices and unlicensed NII

devices shall be subject to the limits for general population/uncontrolled exposure.

(2) For purposes of analyzing mobile transmitting devices under the occupational/controlled criteria specified in Section 1.1310 of this chapter, time averaging provisions of the limits may be used in conjunction with the maximum duty factor to determine maximum time-averaged exposure levels under normal operating conditions.

(3) Such time averaging provisions based on maximum duty factor may not be used in determining exposure levels for devices intended for use by consumers in general population/uncontrolled environments as defined in Section 1.1310 of this chapter. However, "source-based" time averaging based on an inherent property of the RF source is allowed over a time period not to exceed 30 minutes. An example of this is the determination of exposure from a device that uses digital technology such as a time-division multiple-access (TDMA) scheme for transmission of a signal.

* * * * *

8. Section 2.1093 is amended by revising paragraphs (b), (c), and (d) to read as follows:

§ 2.1093 Radiofrequency radiation exposure evaluation: portable devices.

* * * * *

(b) For purposes of this section, the definitions in Section 1.1307(b)(2) of this chapter shall apply. A portable device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that the RF source's radiating structure(s) is/are within 20 centimeters of the body of the user.

(c)(1) Evaluation of compliance with the exposure limits in Section 1.1310 of this chapter, and preparation of an EA if the limits are exceeded, is necessary for portable devices having single RF sources with more than an available maximum time-averaged power of 1 mW, more than the ERP listed in Table 1 of Section 1.1307(b)(3)(i)(C), or more than the P_{th} in the following formula, whichever is greater. The following formula shall only be used in conjunction with portable devices not exempt by Section 1.1307(b)(3)(i)(C) at distances from 0.5 centimeters to 20 centimeters and frequencies from 0.3 GHz to 6 GHz.

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20cm} (d/20 \text{ cm})^N & d \leq 20 \text{ cm} \\ ERP_{20cm} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$$

Where

$$N = -\log_{10} \left(\frac{60}{ERP_{20cm} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}$$

$$ERP_{20cm} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3050 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

d = the minimum separation distance (cm) in any direction from any part of the device antenna(s) or radiating structure(s) to the body of the device user.

(2) For multiple mobile or portable RF sources within a device operating in the same time averaging period, evaluation is required if the formula in Section 1.1307(b)(3)(ii)(B) of this chapter is applied to

determine the exemption ratio and the result is greater than 1.

(3) Unless otherwise specified in this chapter, any other single portable or multiple mobile and portable RF source(s) associated with a device is exempt from routine environmental evaluation for RF exposure prior to equipment authorization or use, except as specified in Sections 1.1307(c) and 1.1307(d) of this chapter.

(d)(1) Applications for equipment authorization of portable RF sources subject to routine environmental evaluation must contain a statement confirming compliance with the limits specified in Section 1.1310 of this chapter as part of their application. Technical information showing the basis for this statement must be submitted to the Commission upon request. The SAR limits specified in Sections 1.1310(a) through (c) of this chapter shall be used for evaluation for evaluation of portable devices transmitting in the frequency range from 100 kHz to 6 GHz. Portable devices that transmit at frequencies above 6 GHz shall be evaluated in terms of the MPE limits specified in Table 1 of Section 1.1310(e)(1) of this chapter. A minimum separation distance applicable to the operating configurations and exposure conditions of the device shall be used for the evaluation. In general, maximum time-averaged power levels must be used for evaluation. All unlicensed personal communications service (PCS) devices and unlicensed NII devices shall be subject to the limits for general population/uncontrolled exposure.

(2) Evaluation of compliance with the SAR limits can be demonstrated by either laboratory measurement techniques or by computational modeling. The latter must be supported by adequate documentation showing that the numerical method as implemented in the computational software has been fully validated; in addition, the equipment under test and exposure conditions must be modeled according to protocols established by FCC-accepted numerical computation standards or available FCC procedures for the specific computational method. Guidance regarding SAR measurement techniques can be found in the Office of Engineering and Technology (OET) Laboratory Division Knowledge Database (KDB). The staff guidance provided in the KDB does not necessarily represent the only acceptable methods for measuring RF exposure or RF emissions, and is not binding on the Commission or any interested party.

(3) For purposes of analyzing portable RF sources under the occupational/controlled SAR criteria specified in Section 1.1310 of this chapter, time averaging provisions of the limits may be used in conjunction with the maximum duty factor to determine maximum time-averaged exposure levels under normal operating conditions.

(4) The time averaging provisions for occupational/controlled SAR criteria, based on maximum duty factor, may not be used in determining typical exposure levels for portable devices intended for use by consumers, such as cellular telephones, that are considered to operate in general population/uncontrolled environments as defined in Section 1.1310 of this chapter. However, "source-based" time averaging based on an inherent property of the RF source is allowed over a time period not to exceed 30 minutes. An example of this would be the determination of exposure from a device that uses digital technology such as a time-division multiple-access (TDMA) scheme for transmission of a signal.

(5) Visual advisories (such as labeling, embossing, or on an equivalent electronic display) on portable devices designed only for occupational use can be used as part of an applicant's evidence of the device user's awareness of occupational/controlled exposure limits. Such visual advisories shall be legible and clearly visible to the user from the exterior of the device. Visual advisories must indicate that the device is for occupational use only, refer the user to specific information on RF exposure, such as that provided in a user manual and note that the advisory and its information is required for FCC RF exposure compliance. Such instructional material must provide users with information on how to use the device and to ensure users are *fully aware* of and able to *exercise control* over their exposure to satisfy compliance with the occupational/controlled exposure limits. A sample of the visual advisory, illustrating its location on the device, and any instructional material intended to accompany the device when

marketed, shall be filed with the Commission along with the application for equipment authorization. Details of any special training requirements pertinent to mitigating and limiting RF exposure should also be submitted. Holders of grants for portable devices to be used in occupational settings are encouraged, but not required, to coordinate with end-user organizations to ensure appropriate RF safety training.

(6) General population/uncontrolled exposure limits defined in Section 1.1310 of this chapter apply to portable devices intended for use by consumers or persons who are exposed as a consequence of their employment and may not be fully aware of the potential for exposure or cannot exercise control over their exposure. No communication with the consumer including either visual advisories or manual instructions will be considered sufficient to allow consumer portable devices to be evaluated subject to limits for occupational/controlled exposure specified in Section 1.1310 of this chapter.

PART 15 – RADIO FREQUENCY DEVICES

9. The authority citation for Part 15 continues to read as follows:

Authority: [INSERT CURRENT AUTHORITY CITATION].

10. Section 15.212 is amended by revising paragraph (a)(viii) to read as follows:

§ 15.212 Modular transmitters.

(a) * * *

(viii) Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in Sections 1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of modular transmitters under this section must contain a statement confirming compliance with these requirements. The modular transmitter must comply with any applicable RF exposure requirements in its final configuration. Technical information showing the basis for this statement must be submitted to the Commission upon request.

* * * * *

11. Section 15.247 is amended by revising paragraph (i) to read as follows:

§ 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

* * * * *

(i) Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in Sections 1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

* * * * *

12. Section 15.255 is amended by revising paragraph (g) to read as follows:

§ 15.255 Operation within the band 57-71 GHz.

* * * * *

(g) Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in Sections 1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

* * * * *

13. Section 15.257 is amended by revising paragraph (g) to read as follows:

§ 15.257 Operation within the band 92-95 GHz.

* * * * *

(g) Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in Sections 1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

* * * * *

14. Section 15.319 is amended by revising paragraph (i) to read as follows:

§ 15.319 General technical requirements.

* * * * *

(i) Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in Sections 1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. All equipment shall be considered to operate in a “general population/uncontrolled” environment. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

* * * * *

15. Section 15.407 is amended by revising paragraph (f) to read as follows:

§ 15.407 General technical requirements.

* * * * *

(f) Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in Sections 1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. All equipment shall be considered to operate in a “general population/uncontrolled” environment. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the

Commission upon request.

* * * * *

16. Section 15.709 is amended by revising paragraph (h) to read as follows:

§ 15.709 General technical requirements.

* * * * *

(h) *Compliance with radio frequency exposure requirements.* TVBDs shall ensure compliance with the Commission's radio frequency exposure requirements in Sections 1.1307(b), 2.1091 and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of modular transmitters under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

PART 18 - INDUSTRIAL, SCIENTIFIC AND MEDICAL EQUIPMENT

17. The authority citation for Part 18 continues to read as follows:

Authority: [INSERT CURRENT AUTHORITY CITATION].

18. A new Section 18.313 is added to read as follows:

§ 18.313 Radio frequency exposure requirements.

Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in Sections 1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate.

PART 22 – PUBLIC MOBILE SERVICES

19. The authority citation for Part 22 continues to read as follows:

Authority: [INSERT CURRENT AUTHORITY CITATION].

20. Section 22.379 is added to read as follows:

§ 22.379 RF exposure.

Licensees and manufacturers shall ensure compliance with the Commission's radio frequency exposure requirements in Sections 1.1307(b), 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

PART 24 – PERSONAL COMMUNICATIONS SERVICES

21. The authority citation for Part 24 continues to read as follows:

Authority: [INSERT CURRENT AUTHORITY CITATION].

22. Section 24.51[Amended]

In Section 24.51, remove and reserve paragraph (c).

23. Section 24.52 is revised to read as follows:

§ 24.52 RF exposure.

Licensees and manufacturers shall ensure compliance with the Commission's radio frequency exposure requirements in Sections 1.1307(b), 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

PART 25 – SATELLITE COMMUNICATIONS

24. The authority citation for Part 1 continues to read as follows:

Authority: [INSERT CURRENT AUTHORITY CITATION].

25. Section 25.115 is amended by adding a new paragraph (p) to read as follows:

§ 25.115 Application for earth station authorizations.

* * * * *

In Section 25.115, reserve paragraphs (l) through (o).

* * * * *

(p) The licensee and grantees shall ensure compliance with the Commission's radio frequency exposure requirements in Sections 1.1307(b), 2.1091, and 2.1093 of this chapter, as appropriate. An Environmental Assessment may be required if RF radiation from the proposed facilities would, in combination with radiation from other sources, cause RF power density or field strength in an accessible area to exceed the applicable limits specified in Section 1.1310 of this chapter. See Section 1.1307(b)(5)(ii).

26. Section 25.117 is amended by revising paragraph (g) to read as follows:

§ 25.117 Modification of station license.

* * * * *

(g) The licensee and grantees shall ensure compliance with the Commission's radio frequency exposure requirements in Sections 1.1307(b), 2.1091, and 2.1093 of this chapter, as appropriate. An Environmental Assessment may be required if RF radiation from the proposed facilities would, in combination with radiation from other sources, cause RF power density or field strength in an accessible area to exceed the applicable limits specified in Section 1.1310 of this chapter. See Section 1.1307(b)(5)(iii).

27. Section 25.129 is amended by revising paragraph (c) to read as follows:

§ 25.129 Equipment authorization for portable earth-station transceivers.

* * * * *

(c) In addition to the information required by Section 2.1033(c) of this chapter, applicants for certification required by this section shall submit any additional equipment test data necessary to demonstrate compliance with pertinent standards for transmitter performance prescribed in Sections 25.138, 25.202(f), 25.204, 25.209, and 25.216, must demonstrate compliance with the labeling requirement in Section 25.285(b), and shall ensure compliance with the Commission's radio frequency exposure requirements in Sections 1.1307(b), 2.1091, and 2.1093 of this chapter, as appropriate. An Environmental Assessment may be required if RF radiation from the proposed facilities would, in combination with radiation from other sources, cause RF power density or field strength in an accessible area to exceed the applicable limits specified in Section 1.1310 of this chapter. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

* * * * *

28. Section 25.149 is amended by revising paragraph (c)(3) to read as follows:

§ 25.149 Application requirements for ancillary terrestrial components in Mobile-Satellite Service networks operating in the 1.5/1.6 GHz and 1.6/2.4 GHz Mobile-Satellite Service.

* * * * *

(c) * * *

(3) Licensees and manufacturers shall ensure compliance with the Commission's radio frequency exposure requirements in Sections 1.1307(b), 2.1091, and 2.1093 of this chapter, as appropriate. An Environmental Assessment may be required if RF radiation from the proposed facilities would, in combination with radiation from other sources, cause RF power density or field strength in an accessible area to exceed the applicable limits specified in Section 1.1310 of this chapter. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

* * * * *

29. Section 25.271 is amended by revising paragraph (g) to read as follows:

§ 25.271 Control of transmitting stations.

* * * * *

(g) All applicants shall ensure compliance with the Commission's radio frequency exposure requirements in Sections 1.1307(b), 2.1091, and 2.1093 of this chapter, as appropriate. Applicants with terminals that will exceed the guidelines in Section 1.1310 of this chapter for radio frequency radiation exposure shall provide a plan for mitigation of radiation exposure to the extent required to meet those guidelines. Licensees of transmitting earth stations are prohibited from using remote earth stations in their networks

that are not designed to stop transmission when synchronization to signals from the target satellite fails.

* * * * *

PART 27 – MISCELLANEOUS WIRELESS COMMUNICATIONS SERVICES

30. The authority citation for Part 27 continues to read as follows:

Authority: [INSERT CURRENT AUTHORITY CITATION].

31. Section 27.52 is revised to read as follows:

§ 27.52 RF exposure.

Licensees and manufacturers shall ensure compliance with the Commission's radio frequency exposure requirements in Sections 1.1307(b), 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

PART 73 – RADIO BROADCAST SERVICES

32. The authority citation for Part 73 continues to read as follows:

Authority: [INSERT CURRENT AUTHORITY CITATION].

33. Section 73.404 is amended by revising paragraph (e)(10) to read as follows:

* * * * *

(e) * * *

(10) Licensees and permittees shall ensure compliance with the Commission's radio frequency exposure requirements in Section 1.1307(b) of this chapter. An Environmental Assessment may be required if RF radiation from the proposed facilities would, in combination with radiation from other sources, cause RF power density or field strength in an accessible area to exceed the applicable limits specified in Section 1.1310 of this chapter.

PART 90 – PRIVATE LAND MOBILE RADIO SERVICES

34. The authority citation for Part 90 continues to read as follows:

Authority: [INSERT CURRENT AUTHORITY CITATION].

35. Section 90.223 is added to read as follows:

§ 90.223 RF exposure.

Licensees and manufacturers shall ensure compliance with the Commission's radio frequency exposure

requirements in Sections 1.1307(b), 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

36. Section 90.1217 is removed.

PART 95 – PERSONAL RADIO SERVICES

37. The authority citation for Part 95 continues to read as follows:

Authority: [INSERT CURRENT AUTHORITY CITATION].

38. Section 95.1125 is revised to read as follows:

§ 95.2385 WMTS RF exposure evaluation.

Mobile and portable devices as defined in Sections 2.1091(b) and 2.1093(b) of this chapter operating in the WMTS are subject to radio frequency radiation exposure requirements as specified in Sections 1.1307(b), 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of WMTS devices must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

39. Section 95.2585 is revised to read as follows:

§ 95.2585 MedRadio RF exposure evaluation.

A MedRadio medical implant device or medical body-worn transmitter is subject to the radiofrequency radiation exposure requirements specified in Sections 1.1307(b) and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of devices operating under this section must demonstrate compliance with these requirements using either computational modeling or laboratory measurement techniques. Where a showing is based on computational modeling, the Commission retains the discretion to request that supporting documentation and/or specific absorption rate (SAR) measurement data be submitted, as described in Section 2.1093(d)(1) of this chapter.

PART 97 – AMATEUR RADIO SERVICE

40. The authority citation for Part 97 continues to read as follows:

Authority: [INSERT CURRENT AUTHORITY CITATION].

41. Section 97.13 is amended by revising paragraph (c)(1) to read as follows:

§ 97.13 Restrictions on station location.

* * * * *

(c) * * *

(1) The licensee shall ensure compliance with the Commission's radio frequency exposure requirements

in Sections 1.1307(b), 2.1091, and 2.1093 of this chapter, where applicable. In lieu of evaluation with the general population/uncontrolled exposure limits, amateur licensees may evaluate their operation with respect to members of his or her immediate household using the occupational/controlled exposure limits in Section 1.1310, provided appropriate training and information has been accessed by the amateur licensee and members of his/her household. RF exposure of other nearby persons who are not members of the amateur licensee's household must be evaluated with respect to the general population/uncontrolled exposure limits. Appropriate methodologies and guidance for evaluating amateur radio service operation is described in the Office of Engineering and Technology (OET) Bulletin 65, Supplement B.

* * * * *

PART 101 – FIXED MICROWAVE SERVICE

42. The authority citation for Part 101 continues to read as follows:

Authority: [INSERT CURRENT AUTHORITY CITATION].

43. Section 101.1425 is revised to read as follows:

§ 101.1425 RF exposure.

MVDDS stations in the 12.2–12.7 GHz frequency band shall ensure compliance with the Commission's radio frequency exposure requirements in Section 1.1307(b) of this chapter. An Environmental Assessment may be required if RF radiation from the proposed facilities would, in combination with radiation from other sources, cause RF power density or field strength in an accessible area to exceed the applicable limits specified in Section 1.1310 of this chapter.

APPENDIX B

Proposed Rules

For the reasons set forth above, Parts 1, 2, and 18 of title 47 of the Code of Federal Regulations are proposed to be amended as follows:

PART 1 – PRACTICE AND PROCEDURE

1. The authority citation for Part 1 continues to read as follows:

Authority: [INSERT CURRENT AUTHORITY CITATION].

2. Section 1.1307 is proposed to be amended by adding a definition to paragraph (b) to read as follows:

§ 1.1307 Actions that may have a significant environmental effect, for which Environmental Assessments (EAs) must be prepared.

* * * * *

(b) * * *

* * * * *

Device-based time averaging is where the instantaneous transmit power and duration of each transmission burst is managed by the device over some specified *time-averaging period* to ensure compliance with the RF exposure limits.

* * * * *

3. Section 1.1310 is proposed to be amended to read as follows:

§ 1.1310 Radiofrequency radiation exposure limits.

(a) Between 3 kHz and 10 MHz (inclusive), internal electric field limits as set forth in paragraph (f) of this section shall be used to evaluate the environmental impact of human exposure to RF radiation as specified in Section 1.1307(b). Specific absorption rate (SAR) shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Section 1.1307(b) within the frequency range of 100 kHz to 6 GHz (inclusive). Power density (PD) shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Section 1.1307(b) for the frequency range above 6 GHz.

(b) The SAR limits for occupational/controlled exposure are 0.4 W/kg, as averaged over the whole body, and a peak spatial-average SAR of 8 W/kg, averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the parts of the human body treated as extremities, such as hands, wrists, feet, ankles, and pinnae, where the peak spatial-average SAR limit for occupational/controlled exposure is 20 W/kg, averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). The PD limits for occupational/controlled exposure are 5 mW/cm², as averaged over the whole body, and a peak spatial-average PD of 20 mW/cm², averaged over any 1 cm². Exposure may be averaged over a time period not to exceed 6 minutes to determine compliance with occupational/controlled SAR limits.

(c) The SAR limits for general population/uncontrolled exposure are 0.08 W/kg, as averaged over the whole body, and a peak spatial-average SAR of 1.6 W/kg, averaged over any 1 gram of tissue (defined as a

tissue volume in the shape of a cube). Exceptions are the parts of the human body treated as extremities, such as hands, wrists, feet, ankles, and pinnae, where the peak spatial-average SAR limit is 4 W/kg, averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). The PD limits for general population/uncontrolled exposure are 1 mW/cm², as averaged over the whole body, and a peak spatial-average PD of 4 mW/cm², averaged over any 1 cm². Exposure may be averaged over a time period not to exceed 30 minutes to determine compliance with general population/uncontrolled SAR limits.

(d)(1) Evaluation with respect to the SAR and/or PD limits in this section must demonstrate compliance with both the whole-body and peak spatial-average limits. Evaluation with respect to both the SAR and PD limits in this section and in Section 2.1093 of this chapter, as well as the internal electric field limits in this section where applicable, shall be done using technically supported measurement or computational methods and exposure conditions in advance of authorization (licensing or equipment certification) and in a manner that facilitates independent assessment and, if appropriate, enforcement. Numerical computation of SAR must be supported by adequate documentation showing that the numerical method as implemented in the computational software has been fully validated; in addition, the equipment under test and exposure conditions must be modeled according to protocols established by FCC-accepted numerical computation standards or available FCC procedures for the specific computational method.

(2) The limits for maximum permissible exposure (MPE) listed in Table 1 of paragraph (e) of this section, which have been derived from whole-body SAR limits, may be used instead of whole-body SAR and/or PD limits as set forth in paragraphs (a) through (c) of this section to evaluate the environmental impact of human exposure to RF radiation as specified in Section 1.1307(b), except for portable devices as defined in Section 2.1093 as these evaluations shall be performed according to the SAR and/or PD provisions, and internal electric field provisions where applicable, in Section 2.1093 of this chapter.

(3) The MPE limits listed in Table 1 of paragraph (e) of this section, the SAR and/or PD limits as set forth in paragraph (a) through (c) of this section and in Section 2.1093 of this chapter, and the internal electric field limits listed in Table 2 of paragraph (f) of this section are for continuous exposure, that is, for indefinite time periods. Except for internal electric field, as described in (f) of this section, exposure levels higher than the limits are permitted for shorter exposure times, as long as the average exposure over a period not to exceed the specified averaging time in Table 1 or source-based time averaging requirement of Sections 2.1091(d)(2) and 2.1093(d)(5) for general population exposure is less than the limits. Detailed information on our policies regarding procedures for evaluating compliance with all of these exposure limits can be found in the FCC's *OET Bulletin 65*, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields," and in supplements to *Bulletin 65*, all available at the FCC's Internet Web site: <http://www.fcc.gov/rfsafety> and in the Office of Engineering and Technology (OET) Laboratory Division Knowledge Database (KDB) (<https://www.fcc.gov/kdb>).

Note to Paragraphs (a) through (d): SAR is a measure of the rate of energy absorption due to exposure to RF electromagnetic energy. These SAR limits to be used for evaluation are based generally on criteria published by the American National Standards Institute (ANSI) for localized SAR in Section 4.2 of "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," ANSI/IEEE Std C95.1-1992, copyright 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," NCRP Report No. 86, Section 17.4.5, copyright 1986 by NCRP, Bethesda, Maryland 20814. Limits for whole body SAR and peak spatial-average SAR are based on recommendations made in both of these documents. Internal electric field limits in Table 2 of paragraph (f) of this section are generally based on guidelines recommended by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) in "ICNIRP Guidelines for Limiting Human Exposure to Time-Varying Electric and Magnetic Fields (1 Hz to 100 kHz)," Published in Volume 99, Issue 6, Pages 818-836, copyright 2010 by the Health Physics Society and available at

<http://www.icnirp.org>. The MPE limits in Table 1 are based generally on criteria published by the NCRP in “Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields,” NCRP Report No. 86, Sections 17.4.1, 17.4.1.1, 17.4.2 and 17.4.3, copyright 1986 by NCRP, Bethesda, Maryland 20814. In the frequency range from 100 MHz to 1500 MHz, these MPE exposure limits for field strength and power density are also generally based on criteria recommended by the ANSI in Section 4.1 of “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz,” ANSI/IEEE Std C95.1-1992, copyright 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. Peak spatial-average PD limits of 4 mW/cm² for general population/uncontrolled exposure and 20 mW/cm² for occupational/controlled exposure in the frequency range from 6 GHz to 300 GHz are generally based on criteria recommended at 6 GHz by the ANSI in Section 4.4 of “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz,” ANSI/IEEE Std C95.1-1992, copyright 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017, and on thermal perception thresholds at frequencies above 6 GHz.

(e)(1) Table 1 sets forth limits for Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic fields.

Table 1—Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	*100	6
3.0-30	1842/f	4.89/f	*900/f ²	6
30-300	61.4	0.163	1.0	6
300-1,500			f/300	6
1,500-3,000,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*100	30
1.34-30	824/f	2.19/f	*180/f ²	30
30-300	27.5	0.073	0.2	30
300-1,500			f/1500	30
1,500-3,000,000			1.0	30

f = frequency in MHz * = Plane-wave equivalent power density, electric and magnetic field strengths are root-mean-square (rms)

(2) * * *

(3) * * *

(3) * * *

(4) * * *

(f) Internal electric field shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Section 1.1307(b) within the frequency range of 3 kHz to 10 MHz (inclusive). Internal electric fields shall be determined as a vector average in a contiguous tissue

volume of $2 \times 2 \times 2$ cubic millimeters. Internal electric fields induced by electric or magnetic fields including transient or very short-term peak fields shall be regarded as instantaneous values not to be time-averaged.

Table 2—Limits for Internal Electric Field

Frequency range (MHz)	Internal electric field strength (rms) (V/m)
(A) Limits for Occupational/Controlled Exposure	
0.003-10	270f
(B) Limits for General Population/Uncontrolled Exposure	
0.003-10	135f

f = frequency in MHz

PART 2 – FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS

4. The authority citation for Part 2 continues to read as follows:

Authority: [INSERT CURRENT AUTHORITY CITATION].

5. Section 2.1091 is proposed to be amended by revising paragraph (d) to read as follows:

§ 2.1091 Radiofrequency radiation exposure evaluation: mobile devices.

* * * * *

(d)(1) Applications for equipment authorization of mobile RF sources subject to routine environmental evaluation must contain a statement confirming compliance with the limits specified in Section 1.1310 of this chapter as part of their application. Technical information showing the basis for this statement must be submitted to the Commission upon request. In general, maximum time-averaged power levels must be used for evaluation. All unlicensed personal communications service (PCS) devices and unlicensed NII devices shall be subject to the limits for general population/uncontrolled exposure.

(2) For purposes of analyzing mobile transmitting devices under the occupational/controlled criteria specified in Section 1.1310 of this chapter, time averaging provisions of the limits may be used in conjunction with maximum duty factor to determine maximum time-averaged exposure levels under normal operating conditions.

(3) Such time averaging provisions based on maximum duty factor may not be used in determining exposure levels for devices intended for use by consumers in general population/uncontrolled environments as defined in Section 1.1310 of this chapter. However, either “source-based” time averaging, based on an inherent property of the RF source, or “device-based” time averaging based on an inherent capability of the device in direct control of the RF source, is allowed.

(4) * * *

(5) * * *

* * * * *

6. Section 2.1093 is proposed to be amended by revising paragraph (d) to read as follows:

§ 2.1093 Radiofrequency radiation exposure evaluation: portable devices.

* * * * *

(d)(1) Applications for equipment authorization of portable RF sources subject to routine environmental evaluation must contain a statement confirming compliance with the limits specified in Section 1.1310 of this chapter as part of their application. Technical information showing the basis for this statement must be submitted to the Commission upon request. In general, maximum time-averaged power levels must be used for evaluation. All unlicensed personal communications service (PCS) devices and unlicensed NII devices shall be subject to the limits for general population/uncontrolled exposure.

(2) Evaluation of compliance with the SAR limits can be demonstrated by either laboratory measurement techniques or by computational modeling. The latter must be supported by adequate documentation showing that the numerical method as implemented in the computational software has been fully validated; in addition, the equipment under test and exposure conditions must be modeled according to protocols established by FCC-accepted numerical computation standards or available FCC procedures for the specific computational method. Guidance regarding SAR, PD, internal electric field, and MPE measurement techniques, where applicable, can be found in the Office of Engineering and Technology (OET) Laboratory Division Knowledge Database (KDB). The staff guidance provided in the KDB does not necessarily represent the only acceptable methods for measuring RF exposure or RF emissions, and is not binding on the Commission or any interested party.

(3) For purposes of analyzing portable RF sources under the occupational/controlled SAR criteria specified in Section 1.1310 of this chapter, the time averaging provisions of these SAR criteria may be used to determine maximum time-averaged exposure levels under normal operating conditions.

(4) The time averaging provisions for occupational/controlled SAR/PD criteria, based on maximum duty factor, may not be used in determining typical exposure levels for portable devices intended for use by consumers, such as cellular telephones, that are considered to operate in general population/uncontrolled environments as defined in Section 1.1310 of this chapter. However, either “source-based” time averaging, based on an inherent property of the RF source, or “device-based” time averaging based on an inherent capability of the device in direct control of the RF source, is allowed, as described in paragraph (d)(6) of this section.

(5) Visual advisories (such as labeling, embossing, or on an equivalent electronic display) on portable devices designed only for occupational use can be used as part of an applicant’s evidence of the device user’s awareness of occupational/controlled exposure limits. Such visual advisories shall be legible and clearly visible to the user from the exterior of the device. Visual advisories must indicate that the device is for occupational use only, refer the user to specific information on RF exposure, such as that provided in a user manual and note that the advisory and its information is required for FCC RF exposure compliance. Such instructional material must provide the user with information on how to use the device in order to ensure compliance with the occupational/controlled exposure limits. A sample of the visual advisory, illustrating its location on the device, and any instructional material intended to accompany the device when marketed, shall be filed with the Commission along with the application for equipment authorization. Details of any special training requirements pertinent to limiting RF exposure should also be submitted. Holders of grants for portable devices to be used in occupational settings are encouraged, but not required, to coordinate with end-user organizations to ensure appropriate RF safety training.

(6) General population/uncontrolled exposure limits defined in Section 1.1310 of this chapter apply to portable devices intended for use by consumers or persons who are exposed as a consequence of their employment and may not be fully aware of the potential for exposure or cannot exercise control over their

exposure. No communication with the consumer including either visual advisories or manual instructions will be considered sufficient to allow consumer portable devices to be evaluated subject to limits for occupational/controlled exposure specified in Section 1.1310 of this chapter.

(7) “Device-based” time averaging, based on an inherent capability of the device in direct control of the RF source(s) within a device, is permitted if the protocols established to track the instantaneous transmit power over a time averaging period not to exceed the values listed in Table 1 for the specific operating frequencies of each transmitter have been validated against available FCC procedures for the “device-based” time averaging method to be used by the device.

Table 1 –Maximum Averaging Times for Device-Based Time Averaging

Frequency (GHz):	< 2.9	2.9-7.125	7.125-10.5	10.5-15.4	15.4-24	24-37	37-53	53-95	> 95
Time (seconds):	100	49	27	14	7	4	3	2	1

* * * * *

PART 18 – INDUSTRIAL, SCIENTIFIC, AND MEDICAL EQUIPMENT

7. The authority citation for Part 18 continues to read as follows:

Authority: [INSERT CURRENT AUTHORITY CITATION].

8. Section 18.107 is proposed to be amended by adding paragraph (k) to read as follows:

§ 18.107 Definitions.

* * * * *

(k) Wireless power transfer (WPT) equipment. A category of ISM equipment which generates and emits RF energy for local use by inductive, capacitive or radiative coupling, for transfer of electromagnetic energy between a power transfer unit (TU) and receiving unit(s) (RU) of a WPT system.

* * * * *

9. A new Section 18.123 is proposed to be added to read as follows:

§ 18.123 Transition Provisions for Wireless Power Transfer Equipment.

All wireless power transfer equipment that are manufactured, imported, marketed or installed on or after [6 months after the effective date of final rules] shall comply with all the provisions for wireless power transfer devices of this part.

* * * * *

10. Section 18.203 is proposed to be amended by adding paragraph (d) to read as follows:

§ 18.203 Equipment authorization.

* * * * *

(d) Wireless power transfer equipment shall be authorized under the Certification procedure prior to use or marketing, in accordance with the relevant sections of part 2, subpart J of this chapter.

* * * * *

11. Section 18.207 is proposed to be amended by adding new paragraph (e)(6) to read as follows:

§ 18.207 Technical report.

* * * * *

(e) * * *

(6) For wireless power transfer equipment, a statement confirming compliance for radio frequency radiation exposure in accordance with the requirements in 47 CFR. Sections 1.1307(b), 1.1310, 2.1091, and 2.1093, as appropriate. Applications for equipment authorization of RF sources operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

* * * * *

APPENDIX C

Initial Regulatory Flexibility Analysis

As required by the Regulatory Flexibility Act of 1980 (RFA),¹ the Commission has prepared this Initial Regulatory Flexibility Analysis (IRFA) of the possible significant economic impact on a substantial number of small entities by the policies and rules proposed in this *Notice of Proposed Rulemaking* (*Notice*).

Written public comments are requested on this IRFA. Comments must be identified as responses to the IRFA and must be filed by the deadlines for comments provided in this *Notice*. The Commission will send a copy of the *Notice*, including this IRFA, to the Chief Counsel for Advocacy of the Small Business Administration (SBA).² In addition, the *Notice* and IRFA (or summaries thereof) will be published in the Federal Register.³

A. Need for, and Objectives of, the Proposed Rules

The National Environmental Policy Act of 1969 (NEPA) requires agencies of the Federal Government to evaluate the effects of their actions on the quality of the human environment.⁴ To meet its responsibilities under NEPA, the Commission has adopted requirements for evaluating the environmental impact of its actions.⁵ One of several environmental factors addressed by these requirements is human exposure to radiofrequency (RF) energy emitted by FCC-regulated transmitters, facilities, and devices.⁶

The *Notice* proposes to amend Parts 1, 2, and 18 of our rules relating to the compliance of FCC-regulated transmitters, facilities, and devices with the guidelines for human exposure to radiofrequency (RF) energy. Specifically, we are proposing to make certain revisions in our rules that we believe will result in more efficient, practical and consistent application of compliance procedures. The *Notice* seeks to develop a record that will enable the Commission to meet the challenges presented by evolving technological advances not resolved in the previous RF exposure proceedings. The *Notice* seeks comment on expanding the range of frequencies for which the RF exposure limits apply; on applying localized exposure limits above 6 GHz in parallel to the localized exposure limits already established below 6 GHz; on specifying the conditions under which and the methods by which the limits are averaged, in both time and area, during evaluation for compliance with the rules; and on addressing new issues raised by Wireless Power Transfer devices.

B. Legal Basis

The proposed action is authorized under Sections 1, 4(i), 4(j), 301, 203, 303(r), 307, 308, 309, 332(a)(1), 332(c)(7)(B)(iv), and 403 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 151, 154(i), 154(j), 301, 302a, 303(r), 307, 308, 309, 332(a)(1), 332(c)(7)(B)(iv), 403; the National Environmental Policy Act of 1969, 42 U.S.C. § 4321 *et seq.*; and Section 704(b) of the Telecommunications Act of 1996,

¹ See 5 U.S.C. § 603. The RFA, *see* 5 U.S.C. §§ 601-612, has been amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), Pub. L. No. 104-121, 110 Stat. 857 (1996).

² See 5 U.S.C. § 603(a).

³ *Id.*

⁴ National Environmental Policy Act of 1969, as amended, 42 U.S.C. §§ 4321-35.

⁵ See 47 CFR pt. 1, subpt. I.

⁶ See 47 CFR § 1.1310; 2013 *Order and Notice*, 28 FCC Rcd 3498, 3505-32, paras. 14-107 (2013).

Pub. L. No. 104-104.

C. Description and Estimate of the Number of Small Entities to Which the Proposed Rules Will Apply

The RFA directs agencies to provide a description of, and where feasible, an estimate of the number of small entities that may be affected by the proposed rules and policies, if adopted.⁷ The RFA generally defines the term “small entity” as having the same meaning as the terms “small business,” “small organization,” and “small governmental jurisdiction.”⁸ In addition, the term “small business” has the same meaning as the term “small business concern” under the Small Business Act.⁹ A “small business concern” is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the SBA.¹⁰

Small Businesses. Nationwide, there are a total of approximately 29.6 million small businesses, according to the SBA.¹¹

Small Businesses, Small Organizations, and Small Governmental Jurisdictions. Our actions, over time, may affect small entities that are not easily categorized at present. We therefore describe here, at the outset, three broad groups of small entities that could be directly affected herein.¹² First, while there are industry specific size standards for small businesses that are used in the regulatory flexibility analysis, according to data from the SBA’s Office of Advocacy, in general a small business is an independent business having fewer than 500 employees.¹³ These types of small businesses represent 99.9% of all businesses in the United States which translates to 28.8 million businesses.¹⁴

Next, the type of small entity described as a “small organization” is generally “any not-for-profit enterprise which is independently owned and operated and is not dominant in its field.”¹⁵ Nationwide, as of Aug 2016, there were approximately 356,494 small organizations based on registration and tax data filed by nonprofits with the Internal Revenue Service (IRS).¹⁶

⁷ 5 U.S.C. § 603(b)(3).

⁸ 5 U.S.C. § 601(6).

⁹ 5 U.S.C. § 601(3) (incorporating by reference the definition of “small-business concern” in the Small Business Act, 15 U.S.C. § 632). Pursuant to 5 U.S.C. § 601(3), the statutory definition of a small business applies “unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register.”

¹⁰ 15 U.S.C. § 632.

¹¹ See SBA, Office of Advocacy, “Frequently Asked Questions,” <http://web.sba.gov/faqs> (accessed Jan. 2009).

¹² See 5 U.S.C. § 601(3)-(6).

¹³ See SBA, Office of Advocacy, “Frequently Asked Questions, Question 1 – What is a small business?” https://www.sba.gov/sites/default/files/advocacy/SB-FAQ-2016_WEB.pdf (June 2016)

¹⁴ See SBA, Office of Advocacy, “Frequently Asked Questions, Question 2- How many small business are there in the U.S.?” https://www.sba.gov/sites/default/files/advocacy/SB-FAQ-2016_WEB.pdf (June 2016).

¹⁵ 5 U.S.C. § 601(4).

¹⁶ Data from the Urban Institute, National Center for Charitable Statistics (NCCS) reporting on nonprofit organizations registered with the IRS was used to estimate the number of small organizations. Reports generated using the NCCS online database indicated that as of August 2016 there were 356,494 registered nonprofits with total revenues of less than \$100,000. Of this number 326,897 entities filed tax returns with 65,113 registered nonprofits reporting total revenues of \$50,000 or less on the IRS Form 990-N for Small Exempt Organizations and 261,784 nonprofits reporting total revenues of \$100,000 or less on some other version of the IRS Form 990 within 24 months

(continued....)

Finally, the small entity described as a “small governmental jurisdiction” is defined generally as “governments of cities, counties, towns, townships, villages, school districts, or special districts, with a population of less than fifty thousand.”¹⁷ U.S. Census Bureau data from the 2012 Census of Governments¹⁸ indicates that there were 90,056 local governmental jurisdictions consisting of general purpose governments and special purpose governments in the United States.¹⁹ Of this number there were 37, 132 General purpose governments (county²⁰, municipal and town or township²¹) with populations of less than 50,000 and 12,184 Special purpose governments (independent school districts²² and special districts²³) with populations of less than 50,000. The 2012 U.S. Census Bureau data for most types of governments in the local government category shows that the majority of these governments have populations of less than 50,000.²⁴ Based on this data we estimate that at least 49,316 local government jurisdictions fall in the category of “small governmental jurisdictions.”²⁵

Experimental Radio Service (Other Than Broadcast). The majority of experimental licenses are issued to companies such as Motorola and Department of Defense contractors such as Northrop,

(Continued from previous page)

of the August 2016 data release date. See <http://nccsweb.urban.org/tablewiz/bmf.php> where the report showing this data can be generated by selecting the following data fields: Show: “Registered Nonprofit Organizations”; By: “Total Revenue Level (years 1995, Aug to 2016, Aug)”; and For: “2016, Aug” then selecting “Show Results”.

¹⁷ 5 U.S.C. § 601(5).

¹⁸ See 13 U.S.C. § 161. The Census of Government is conducted every five (5) years compiling data for years ending with “2” and “7”. See also Program Description Census of Government <https://factfinder.census.gov/faces/affhelp/jsf/pages/metadata.xhtml?lang=en&type=program&id=program.en.CO G#>.

¹⁹ See U.S. Census Bureau, 2012 Census of Governments, Local Governments by Type and State: 2012 - United States-States. <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG02.US01>. Local governmental jurisdictions are classified in two categories - General purpose governments (county, municipal and town or township) and Special purpose governments (special districts and independent school districts).

²⁰ See U.S. Census Bureau, 2012 Census of Governments, County Governments by Population-Size Group and State: 2012 - United States-States. <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG06.US01>. There were 2,114 county governments with populations less than 50,000.

²¹ See U.S. Census Bureau, 2012 Census of Governments, Subcounty General-Purpose Governments by Population-Size Group and State: 2012 - United States – States. <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG07.US01>. There were 18,811 municipal and 16,207 town and township governments with populations less than 50,000.

²² See U.S. Census Bureau, 2012 Census of Governments, Elementary and Secondary School Systems by Enrollment-Size Group and State: 2012 - United States-States. <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG11.US01>. There were 12,184 independent school districts with enrollment populations less than 50,000.

²³ See U.S. Census Bureau, 2012 Census of Governments, Special District Governments by Function and State: 2012 - United States-States. <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG09.US01>. [The U.S. Census Bureau data did not provide a population breakout for special district governments.](#)

²⁴ See U.S. Census Bureau, 2012 Census of Governments, County Governments by Population-Size Group and State: 2012 - United States-States - <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG06.US01>; Subcounty General-Purpose Governments by Population-Size Group and State: 2012 - United States-States - <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG07.US01>; and Elementary and Secondary School Systems by Enrollment-Size Group and State: 2012 - United States-States. <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG11.US01>. [While U.S. Census Bureau data did not provide a population breakout for special district governments, if the population of less than 50,000 for this category of local government is consistent with the other types of local governments the majority of the 38, 266 special district governments have populations of less than 50,000.](#)

²⁵ *Id.*

Lockheed and Martin Marietta. Businesses such as these may have as many as 200 licenses at one time. The majority of these applications are from entities such as these. Given this fact, the remaining 30 percent of applications, we assume, for purposes of our evaluations and conclusions in this FRFA, will be awarded to small entities, as that term is defined by the SBA.

The Commission processes approximately 1,000 applications a year for experimental radio operations. About half or 500 of these are renewals and the other half are for new licenses. We do not have adequate information to predict precisely how many of these applications will be impacted by our rule revisions. However, based on the above figures we estimate that as many as 300 of these applications could be from small entities and potentially could be impacted.

International Broadcast Stations. Commission records show that there are 19 international high frequency broadcast station authorizations. We do not request nor collect annual revenue information, and are unable to estimate the number of international high frequency broadcast stations that would constitute a small business under the SBA definition. Since all international broadcast stations operate using relatively high power levels, it is likely that they could all be impacted by our proposed rule revisions.

Satellite Telecommunications Providers. Two economic census categories address the satellite industry. The first category has a small business size standard of \$15 million or less in average annual receipts, under SBA rules.²⁶ The second has a size standard of \$25 million or less in annual receipts.²⁷ The category of Satellite Telecommunications “comprises establishments primarily engaged in providing telecommunications services to other establishments in the telecommunications and broadcasting industries by forwarding and receiving communications signals via a system of satellites or reselling satellite telecommunications.”²⁸ Census Bureau data for 2007 show that 512 Satellite Telecommunications firms that operated for that entire year.²⁹ Of this total, 464 firms had annual receipts of under \$10 million, and 18 firms had receipts of \$10 million to \$24,999,999.³⁰ Consequently, the Commission estimates that the majority of Satellite Telecommunications firms are small entities that might be affected by our proposals.

The second category, i.e., “All Other Telecommunications” comprises “establishments primarily engaged in providing specialized telecommunications services, such as satellite tracking, communications telemetry, and radar station operation. This industry also includes establishments primarily engaged in providing satellite terminal stations and associated facilities connected with one or more terrestrial systems and capable of transmitting telecommunications to, and receiving telecommunications from, satellite systems. Establishments providing Internet services or voice over Internet protocol (VoIP) services via client-supplied telecommunications connections are also included in this industry.”³¹ For this category, Census Bureau data for 2007 shows that there were a total of 2,383 firms that operated for the entire year.³² Of this total, 2,347 firms had annual receipts of under \$25 million and 12 firms had annual

²⁶ 13 CFR § 121.201, NAICS code 517410.

²⁷ 13 CFR § 121.201, NAICS code 517919.

²⁸ U.S. Census Bureau, 2007 NAICS Definitions, 517410 Satellite Telecommunications.

²⁹ See http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-skip=900&-ds_name=EC0751SSSZ4&-lang=en.

³⁰ See http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-skip=900&-ds_name=EC0751SSSZ4&-lang=en.

³¹ <http://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517919&search=2007%20NAICS%20Search>.

³² http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-skip=900&-ds_name=EC0751SSSZ4&-lang=en.

receipts of \$25 million to \$49, 999,999.³³ Consequently, the Commission estimates that the majority of All Other Telecommunications firms are small entities that might be affected by our action.

Fixed Satellite Transmit/Receive Earth Stations. There are approximately 4,303 earth station authorizations, a portion of which are Fixed Satellite Transmit/Receive Earth Stations. We do not request nor collect annual revenue information, and are unable to estimate the number of the earth stations that would constitute a small business under the SBA definition. However, the majority of these stations could be impacted by our proposed rules.

Fixed Satellite Small Transmit/Receive Earth Stations. There are approximately 4,303 earth station authorizations, a portion of which are Fixed Satellite Small Transmit/Receive Earth Stations. We do not request nor collect annual revenue information, and are unable to estimate the number of fixed small satellite transmit/receive earth stations that would constitute a small business under the SBA definition. However, the majority of these stations could be impacted by our proposed rules.

Fixed Satellite Very Small Aperture Terminal (VSAT) Systems. These stations operate on a primary basis, and frequency coordination with terrestrial microwave systems is not required. Thus, a single “blanket” application may be filed for a specified number of small antennas and one or more hub stations. There are 492 current VSAT System authorizations. We do not request nor collect annual revenue information, and are unable to estimate the number of VSAT systems that would constitute a small business under the SBA definition. However, it is expected that many of these stations could be impacted by our proposed rules.

Mobile Satellite Earth Stations. There are 19 licensees. We do not request nor collect annual revenue information, and are unable to estimate the number of mobile satellite earth stations that would constitute a small business under the SBA definition. However, it is expected that many of these stations could be impacted by our proposed rules.

Wireless Telecommunications Carriers (except satellite). This industry comprises establishments engaged in operating and maintaining switching and transmission facilities to provide communications via the airwaves. Establishments in this industry have spectrum licenses and provide services using that spectrum, such as cellular phone services, paging services, wireless Internet access, and wireless video services.³⁴ The appropriate size standard under SBA rules is for the category Wireless Telecommunications Carriers. The size standard for that category is that a business is small if it has 1,500 or fewer employees.³⁵ Under the present and prior categories, the SBA has deemed a wireless business to be small if it has 1,500 or fewer employees.³⁶ For this category, census data for 2007 show that there were 1,383 firms that operated for the entire year.³⁷ Of this total, 1,368 firms had employment of 999 or fewer employees and 15 had employment of 1000 employees or more.³⁸ Thus under this category and the associated small business size standard, , the Commission estimates that the majority of wireless

³³http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-skip=900&-ds_name=EC0751SSSZ4&-lang=en.

³⁴ <http://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517210&search=2007%20NAICS%20Search>

³⁵ 13 CFR § 121.201, NAICS code 517210.

³⁶ 13 CFR § 121.201, NAICS code 517210. The now-superseded, pre-2007 CFR citations were 13 CFR § 121.201, NAICS codes 517211 and 517212 (referring to the 2002 NAICS).

³⁷ U.S. Census Bureau, Subject Series: Information, Table 5, “Establishment and Firm Size: Employment Size of Firms for the United States: 2007 NAICS Code 517210” (issued Nov. 2010).

³⁸ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

telecommunications carriers(except satellite) are small entities that may be affected by our proposed action.³⁹

Licenses Assigned by Auctions. Initially, we note that, as a general matter, the number of winning bidders that qualify as small businesses at the close of an auction does not necessarily represent the number of small businesses currently in service. Also, the Commission does not generally track subsequent business size unless, in the context of assignments or transfers, unjust enrichment issues are implicated.

Paging Services. Neither the SBA nor the FCC has developed a definition applicable exclusively to paging services. However, a variety of paging services is now categorized under Wireless Telecommunications Carriers (except satellite).⁴⁰ This industry comprises establishments engaged in operating and maintaining switching and transmission facilities to provide communications via the airwaves. Establishments in this industry have spectrum licenses and provide services using that spectrum, such as cellular phone services, paging services, wireless Internet access, and wireless video services. Illustrative examples in the paging context include paging services, except satellite; two-way paging communications carriers, except satellite; and radio paging services communications carriers. The SBA has deemed a paging service in this category to be small if it has 1,500 or fewer employees.⁴¹ For this category, census data for 2007 show that there were 1,383 firms that operated for the entire year.⁴² Of this total, 1,368 firms had employment of 999 or fewer employees and 15 had employment of 1000 employees or more.⁴³ Thus under this category and the associated small business size standard, the Commission estimates that the majority of paging services in the category of wireless telecommunications carriers(except satellite) are small entities that may be affected by our proposed action.⁴⁴

In addition, in the Paging Second Report and Order, the Commission adopted a size standard for “small businesses” for purposes of determining their eligibility for special provisions such as bidding credits.⁴⁵ A small business is an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$15 million for the preceding three years.⁴⁶ The SBA has approved this definition.⁴⁷ An initial auction of Metropolitan Economic Area (“MEA”) licenses was conducted in the

³⁹See http://factfinder.census.gov/servlet/IBQTable?_bm=y&-fds_name=EC0700A1&-geo_id=&-skip=600&-ds_name=EC0751SSSZ5&-lang=en.

⁴⁰ U.S. Census Bureau, 2007 NAICS Definitions, “517210 Wireless Telecommunications Categories (Except Satellite)”; <http://www.census.gov/naics/2007/def/ND517210.HTM#N517210>.

⁴¹ U.S. Census Bureau, 2007 NAICS Definitions, “517210 Wireless Telecommunications Categories (Except Satellite)”

⁴² U.S. Census Bureau, Subject Series: Information, Table 5, “Establishment and Firm Size: Employment Size of Firms for the United States: 2007 NAICS Code 517210” (issued Nov. 2010).

⁴³ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

⁴⁴See http://factfinder.census.gov/servlet/IBQTable?_bm=y&-fds_name=EC0700A1&-geo_id=&-skip=600&-ds_name=EC0751SSSZ5&-lang=en.

⁴⁵ *Revision of Part 22 and Part 90 of the Commission’s Rules to Facilitate Future Development of Paging Systems*, Second Report and Order, 12 FCC Rcd 2732, 2811-2812, paras. 178-181 (“*Paging Second Report and Order*”); see also *Revision of Part 22 and Part 90 of the Commission’s Rules to Facilitate Future Development of Paging Systems*, Memorandum Opinion and Order on Reconsideration, 14 FCC Rcd 10030, 10085-10088, ¶¶ 98-107 (1999).

⁴⁶ *Paging Second Report and Order*, 12 FCC Rcd at 2811, ¶ 179.

⁴⁷ See Letter from Aida Alvarez, Administrator, SBA, to Amy Zoslov, Chief, Auctions and Industry Analysis Division, Wireless Telecommunications Bureau (“WTB”), FCC (Dec. 2, 1998) (“*Alvarez Letter 1998*”).

year 2000. Of the 2,499 licenses auctioned, 985 were sold.⁴⁸ Fifty-seven companies claiming small business status won 440 licenses.⁴⁹ A subsequent auction of MEA and Economic Area (“EA”) licenses was held in the year 2001. Of the 15,514 licenses auctioned, 5,323 were sold.⁵⁰ One hundred thirty-two companies claiming small business status purchased 3,724 licenses. A third auction, consisting of 8,874 licenses in each of 175 EAs and 1,328 licenses in all but three of the 51 MEAs, was held in 2003. Seventy-seven bidders claiming small or very small business status won 2,093 licenses.⁵¹ A fourth auction of 9,603 lower and upper band paging licenses was held in the year 2010. 29 bidders claiming small or very small business status won 3,016 licenses.

2.3 GHz Wireless Communications Services. This service can be used for fixed, mobile, radiolocation, and digital audio broadcasting satellite uses. The Commission defined “small business” for the wireless communications services (“WCS”) auction as an entity with average gross revenues of \$40 million for each of the three preceding years, and a “very small business” as an entity with average gross revenues of \$15 million for each of the three preceding years.⁵² The SBA approved these definitions.⁵³ The Commission conducted an auction of geographic area licenses in the WCS service in 1997. In the auction, seven bidders that qualified as very small business entities won 31 licenses, and one bidder that qualified as a small business entity won a license.

1670-1675 MHz Services. This service can be used for fixed and mobile uses, except aeronautical mobile.⁵⁴ An auction for one license in the 1670-1675 MHz band was conducted in 2003. The Commission defined a “small business” as an entity with attributable average annual gross revenues of not more than \$40 million for the preceding three years, which would thus be eligible for a 15 percent discount on its winning bid for the 1670-1675 MHz band license. Further, the Commission defined a “very small business” as an entity with attributable average annual gross revenues of not more than \$15 million for the preceding three years, which would thus be eligible to receive a 25 percent discount on its winning bid for the 1670-1675 MHz band license. The winning bidder was not a small entity.

Wireless Telephony. Wireless telephony includes cellular, personal communications services, and specialized mobile radio telephony carriers. As noted, the SBA has developed a small business size standard for Wireless Telecommunications Carriers (except Satellite).⁵⁵ Under the SBA small business size standard, a business is small if it has 1,500 or fewer employees.⁵⁶ Census data for 2007 shows that there were 1,383 firms that operated that year.⁵⁷ Of those 1,383, 1,368 had fewer than 100 employees,

⁴⁸ See “929 and 931 MHz Paging Auction Closes,” Public Notice, 15 FCC Rcd 4858 (WTB 2000).

⁴⁹ See *id.*

⁵⁰ See “Lower and Upper Paging Band Auction Closes,” Public Notice, 16 FCC Rcd 21821 (WTB 2002).

⁵¹ See “Lower and Upper Paging Bands Auction Closes,” Public Notice, 18 FCC Rcd 11154 (WTB 2003). The current number of small or very small business entities that hold wireless licenses may differ significantly from the number of such entities that won in spectrum auctions due to assignments and transfers of licenses in the secondary market over time. In addition, some of the same small business entities may have won licenses in more than one auction.

⁵² *Amendment of the Commission’s Rules to Establish Part 27, the Wireless Communications Service (WCS)*, Report and Order, 12 FCC Rcd 10785, 10879, para. 194 (1997).

⁵³ See *Alvarez Letter 1998*.

⁵⁴ 47 CFR § 2.106; see generally 47 CFR §§ 27.1–70.

⁵⁵ 13 CFR § 121.201, NAICS code 517210.

⁵⁶ *Id.*

⁵⁷ U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-skip=700&-

and 15 firms had more than 100 employees. Thus under this category and the associated small business size standard, the majority of firms can be considered small. According to Trends in Telephone Service data, 434 carriers reported that they were engaged in wireless telephony.⁵⁸ Of these, an estimated 222 have 1,500 or fewer employees and 212 have more than 1,500 employees.⁵⁹ Therefore, approximately half of these entities can be considered small. Similarly, according to Commission data, 413 carriers reported that they were engaged in the provision of wireless telephony, including cellular service, Personal Communications Service (PCS), and Specialized Mobile Radio (SMR) Telephony services.⁶⁰ Of these, an estimated 261 have 1,500 or fewer employees and 152 have more than 1,500 employees.⁶¹ Consequently, the Commission estimates that approximately half or more of these firms can be considered small. Thus, using available data, we estimate that the majority of wireless firms can be considered small.

Broadband Personal Communications Service. *Broadband Personal Communications Service.* The broadband personal communications services (PCS) spectrum is divided into six frequency blocks designated A through F, and the Commission has held auctions for each block. The Commission initially defined a “small business” for C- and F-Block licenses as an entity that has average gross revenues of \$40 million or less in the three previous years.⁶² For F-Block licenses, an additional small business size standard for “very small business” was added and is defined as an entity that, together with its affiliates, has average gross revenues of not more than \$15 million for the preceding three years.⁶³ These small business size standards, in the context of broadband PCS auctions, have been approved by the SBA.⁶⁴ No small businesses within the SBA-approved small business size standards bid successfully for licenses in Blocks A and B. There were 90 winning bidders that claimed small business status in the first two C-Block auctions. A total of 93 bidders that claimed small and very small business status won approximately 40 percent of the 1,479 licenses in the first auction for the D, E, and F Blocks.⁶⁵ On April 15, 1999, the Commission completed the re-auction of 347 C-, D-, E-, and F-Block licenses in Auction No. 22.⁶⁶ Of the 57 winning bidders in that auction, 48 claimed small business status and won 277 licenses.

On January 26, 2001, the Commission completed the auction of 422 C and F Block Broadband PCS

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⁵⁸ *Trends in Telephone Service*, at Tbl. 5.3.

⁵⁹ *Id.*

⁶⁰ *See Trends in Telephone Service*, at Tbl. 5.3.

⁶¹ *See id.*

⁶² *See Amendment of Parts 20 and 24 of the Commission's Rules – Broadband PCS Competitive Bidding and the Commercial Mobile Radio Service Spectrum Cap; Amendment of the Commission's Cellular/PCS Cross-Ownership Rule*, WT Docket No. 96-59, GN Docket No. 90-314, Report and Order, 11 FCC Rcd 7824, 7850–52 ¶¶ 57–60 (1996) (“*PCS Report and Order*”); *see also* 47 CFR § 24.720(b).

⁶³ *See PCS Report and Order*, 11 FCC Rcd at 7852 ¶ 60.

⁶⁴ *See Alvarez Letter 1998*.

⁶⁵ *See Broadband PCS, D, E and F Block Auction Closes*, Public Notice, Doc. No. 89838 (rel. Jan. 14, 1997).

⁶⁶ *See C, D, E, and F Block Broadband PCS Auction Closes*, Public Notice, 14 FCC Rcd 6688 (WTB 1999). Before Auction No. 22, the Commission established a very small standard for the C Block to match the standard used for F Block. *Amendment of the Commission's Rules Regarding Installment Payment Financing for Personal Communications Services (PCS) Licensees*, WT Docket No. 97-82, Fourth Report and Order, 13 FCC Rcd 15743, 15768 ¶ 46 (1998).

licenses in Auction No. 35. Of the 35 winning bidders in that auction, 29 claimed small business status.⁶⁷ Subsequent events concerning Auction 35, including judicial and agency determinations, resulted in a total of 163 C and F Block licenses being available for grant. On February 15, 2005, the Commission completed an auction of 242 C-, D-, E-, and F-Block licenses in Auction No. 58. Of the 24 winning bidders in that auction, 16 claimed small business status and won 156 licenses.⁶⁸ On May 21, 2007, the Commission completed an auction of 33 licenses in the A, C, and F Blocks in Auction No. 71.⁶⁹ Of the 14 winning bidders in that auction, six claimed small business status and won 18 licenses.⁷⁰ On August 20, 2008, the Commission completed the auction of 20 C-, D-, E-, and F-Block Broadband PCS licenses in Auction No. 78.⁷¹ Of the eight winning bidders for Broadband PCS licenses in that auction, six claimed small business status and won 14 licenses.⁷²

Advanced Wireless Services. In 2006, the Commission conducted its first auction of Advanced Wireless Services licenses in the 1710-1755 MHz and 2110-2155 MHz bands (“AWS-1”), designated as Auction 66.⁷³ For the AWS-1 bands, the Commission has defined a “small business” as an entity with average annual gross revenues for the preceding three years not exceeding \$40 million, and a “very small business” as an entity with average annual gross revenues for the preceding three years not exceeding \$15 million.⁷⁴ In 2006, the Commission conducted its first auction of AWS-1 licenses.⁷⁵ In that initial AWS-1 auction, 31 winning bidders identified themselves as very small businesses won 142 licenses.⁷⁶ Twenty-six of the winning bidders identified themselves as small businesses and won 73 licenses.⁷⁷ In a subsequent 2008 auction, the Commission offered 35 AWS-1 licenses.⁷⁸ Four winning bidders identified themselves as very small businesses, and three of the winning bidders identifying themselves as a small

⁶⁷ See *C and F Block Broadband PCS Auction Closes; Winning Bidders Announced*, Public Notice, 16 FCC Rcd 2339 (2001).

⁶⁸ See *Broadband PCS Spectrum Auction Closes; Winning Bidders Announced for Auction No. 58*, Public Notice, 20 FCC Rcd 3703 (2005).

⁶⁹ See *Auction of Broadband PCS Spectrum Licenses Closes; Winning Bidders Announced for Auction No. 71*, Public Notice, 22 FCC Rcd 9247 (2007).

⁷⁰ *Id.*

⁷¹ See *Auction of AWS-1 and Broadband PCS Licenses Closes; Winning Bidders Announced for Auction 78*, Public Notice, 23 FCC Rcd 12749 (WTB 2008).

⁷² *Id.*

⁷³ See *Auction of Advanced Wireless Services Licenses Scheduled for June 29, 2006; Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments and Other Procedures for Auction No. 66*, AU Docket No. 06-30, Public Notice, 21 FCC Rcd 4562 (2006) (“*Auction 66 Procedures Public Notice*”);

⁷⁴ See *Service Rules for Advanced Wireless Services in the 1.7 GHz and 2.1 GHz Bands, Report and Order*, 18 FCC Rcd 25,162, App. B (2003), modified by *Service Rules for Advanced Wireless Services In the 1.7 GHz and 2.1 GHz Bands, Order on Reconsideration*, 20 FCC Rcd 14,058, App. C (2005).

⁷⁵ See *Auction of Advanced Wireless Services Licenses Scheduled for June 29, 2006; Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments and Other Procedures for Auction No. 66*, AU Docket No. 06-30, Public Notice, 21 FCC Rcd 4562 (2006) (“*Auction 66 Procedures Public Notice*”).

⁷⁶ See *Auction of Advanced Wireless Services Licenses Closes; Winning Bidders Announced for Auction No. 66*, Public Notice, 21 FCC Rcd 10,521 (2006) (“*Auction 66 Closing Public Notice*”).

⁷⁷ See *id.*

⁷⁸ See *AWS-1 and Broadband PCS Procedures Public Notice*, 23 FCC Rcd at 7499. Auction 78 also included an auction of broadband PCS licenses.

businesses won five AWS-1 licenses.⁷⁹

Narrowband Personal Communications Services. In 1994, the Commission conducted two auctions of Narrowband PCS licenses. For these auctions, the Commission defined a “small business” as an entity with average annual gross revenues for the preceding three years not exceeding \$40 million.⁸⁰ Through these auctions, the Commission awarded a total of 41 licenses, 11 of which were obtained by four small businesses.⁸¹ To ensure meaningful participation by small business entities in future auctions, the Commission adopted a two-tiered small business size standard in the *Narrowband PCS Second Report and Order*.⁸² A “small business” is an entity that, together with affiliates and controlling interests, has average gross revenues for the three preceding years of not more than \$40 million.⁸³ A “very small business” is an entity that, together with affiliates and controlling interests, has average gross revenues for the three preceding years of not more than \$15 million.⁸⁴ The SBA has approved these small business size standards.⁸⁵ A third auction of Narrowband PCS licenses was conducted in 2001. In that auction, five bidders won 317 (Metropolitan Trading Areas and nationwide) licenses.⁸⁶ Three of the winning bidders claimed status as a small or very small entity and won 311 licenses.

Lower 700 MHz Band Licenses. The Commission previously adopted criteria for defining three groups of small businesses for purposes of determining their eligibility for special provisions such as bidding credits.⁸⁷ The Commission defined a “small business” as an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$40 million for the preceding three years.⁸⁸ A “very small business” is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues that are not more than \$15 million for the preceding three years.⁸⁹ Additionally, the Lower 700 MHz Service had a third category of small business status for Metropolitan/Rural Service Area (“MSA/RSA”) licenses —“entrepreneur”— which is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues that are not

⁷⁹ See *Auction of AWS-1 and Broadband PCS Licenses Closes, Winning Bidders Announced for Auction 78, Down Payments Due September 9, 2008, FCC Forms 601 and 602 Due September 9, 2008, Final Payments Due September 23, 2008, Ten-Day Petition to Deny Period*, Public Notice, 23 FCC Rcd 12,749 (2008).

⁸⁰ *Implementation of Section 309(j) of the Communications Act – Competitive Bidding Narrowband PCS*, Third Memorandum Opinion and Order and Further Notice of Proposed Rulemaking, 10 FCC Rcd 175, 196, para. 46 (1994).

⁸¹ See “Announcing the High Bidders in the Auction of Ten Nationwide Narrowband PCS Licenses, Winning Bids Total \$617,006,674,” *Public Notice*, PNWL 94-004 (rel. Aug. 2, 1994); “Announcing the High Bidders in the Auction of 30 Regional Narrowband PCS Licenses; Winning Bids Total \$490,901,787,” *Public Notice*, PNWL 94-27 (rel. Nov. 9, 1994).

⁸² *Amendment of the Commission’s Rules to Establish New Personal Communications Services, Narrowband PCS, Second Report and Order and Second Further Notice of Proposed Rule Making*, 15 FCC Rcd 10456, 10476, para. 40 (2000) (“*Narrowband PCS Second Report and Order*”).

⁸³ *Narrowband PCS Second Report and Order*, 15 FCC Rcd at 10476, para. 40.

⁸⁴ *Id.*

⁸⁵ See *Alvarez Letter 1998*.

⁸⁶ See “Narrowband PCS Auction Closes,” *Public Notice*, 16 FCC Rcd 18663 (WTB 2001).

⁸⁷ See *Reallocation and Service Rules for the 698-746 MHz Spectrum Band (Television Channels 52-59)*, Report and Order, 17 FCC Rcd 1022 (2002) (“*Channels 52-59 Report and Order*”).

⁸⁸ See *Channels 52-59 Report and Order*, 17 FCC Rcd at 1087-88, ¶ 172.

⁸⁹ See *id.*

more than \$3 million for the preceding three years.⁹⁰ The SBA approved these small size standards.⁹¹ An auction of 740 licenses was conducted in 2002 (one license in each of the 734 MSAs/RSAs and one license in each of the six Economic Area Groupings (EAGs)). Of the 740 licenses available for auction, 484 licenses were won by 102 winning bidders. Seventy-two of the winning bidders claimed small business, very small business, or entrepreneur status and won a total of 329 licenses.⁹² A second auction commenced on May 28, 2003, closed on June 13, 2003, and included 256 licenses.⁹³ Seventeen winning bidders claimed small or very small business status and won 60 licenses, and nine winning bidders claimed entrepreneur status and won 154 licenses.⁹⁴ In 2005, the Commission completed an auction of 5 licenses in the lower 700 MHz band (Auction 60). All three winning bidders claimed small business status.

In 2007, the Commission reexamined its rules governing the 700 MHz band in the *700 MHz Second Report and Order*.⁹⁵ An auction of A, B and E block licenses in the Lower 700 MHz band was held in 2008.⁹⁶ Twenty winning bidders claimed small business status (those with attributable average annual gross revenues that exceed \$15 million and do not exceed \$40 million for the preceding three years). Thirty three winning bidders claimed very small business status (those with attributable average annual gross revenues that do not exceed \$15 million for the preceding three years). In 2011, the Commission conducted Auction 92, which offered 16 lower 700 MHz band licenses that had been made available in Auction 73 but either remained unsold or were licenses on which a winning bidder defaulted. Two of the seven winning bidders in Auction 92 claimed very small business status, winning a total of four licenses.

Upper 700 MHz Band Licenses. In the *700 MHz Second Report and Order*, the Commission revised its rules regarding Upper 700 MHz licenses.⁹⁷ On January 24, 2008, the Commission commenced Auction 73 in which several licenses in the Upper 700 MHz band were available for licensing: 12 Regional Economic Area Grouping licenses in the C Block, and one nationwide license in the D Block.⁹⁸ The auction concluded on March 18, 2008, with 3 winning bidders claiming very small business status (those with attributable average annual gross revenues that do not exceed \$15 million for the preceding three years) and winning five licenses.

⁹⁰ See *id.*, 17 FCC Rcd at 1088, ¶ 173.

⁹¹ See Letter from Aida Alvarez, Administrator, SBA, to Thomas Sugrue, Chief, WTB, FCC (Aug. 10, 1999) (“*Alvarez Letter 1999*”).

⁹² See “Lower 700 MHz Band Auction Closes,” *Public Notice*, 17 FCC Rcd 17272 (WTB 2002).

⁹³ See Lower 700 MHz Band Auction Closes, *Public Notice*, 18 FCC Rcd 11873 (WTB 2003).

⁹⁴ See *id.*

⁹⁵ Service Rules for the 698-746, 747-762 and 777-792 MHz Band, WT Docket No. 06-150, *Revision of the Commission’s Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems*, CC Docket No. 94-102, Section 68.4(a) of the Commission’s Rules Governing Hearing Aid-Compatible Telephone, WT Docket No. 01-309, *Biennial Regulatory Review – Amendment of Parts 1, 22, 24, 27, and 90 to Streamline and Harmonize Various Rules Affecting Wireless Radio Services*, WT Docket No. 03-264, *Former Nextel Communications, Inc. Upper 700 MHz Guard Band Licenses and Revisions to Part 27 of the Commission’s Rules*, WT Docket No. 06-169, *Implementing a Nationwide, Broadband Interoperable Public Safety Network in the 700 MHz Band*, PS Docket No. 06-229, *Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State, and Local Public Safety Communications Requirements Through the Year 2010*, WT Docket No. 96-86, *Second Report and Order*, 22 FCC Rcd 15289 (2007) (“*700 MHz Second Report and Order*”).

⁹⁶ See Auction of 700 MHz Band Licenses Closes, *Public Notice*, 23 FCC Rcd 4572 (WTB 2008).

⁹⁷ *700 MHz Second Report and Order*, 22 FCC Rcd 15289.

⁹⁸ See Auction of 700 MHz Band Licenses Closes, *Public Notice*, 23 FCC Rcd 4572 (WTB 2008).

700 MHz Guard Band Licenses. In 2000, the Commission adopted the *700 MHz Guard Band Report and Order*, in which it established rules for the A and B block licenses in the Upper 700 MHz band, including size standards for “small businesses” and “very small businesses” for purposes of determining their eligibility for special provisions such as bidding credits.⁹⁹ A small business in this service is an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$40 million for the preceding three years.¹⁰⁰ Additionally, a very small business is an entity that, together with its affiliates and controlling principals, has average gross revenues that are not more than \$15 million for the preceding three years.¹⁰¹ SBA approval of these definitions is not required.¹⁰² An auction of these licenses was conducted in 2000.¹⁰³ Of the 104 licenses auctioned, 96 licenses were won by nine bidders. Five of these bidders were small businesses that won a total of 26 licenses. A second auction of 700 MHz Guard Band licenses was held in 2001. All eight of the licenses auctioned were sold to three bidders. One of these bidders was a small business that won a total of two licenses.¹⁰⁴

Specialized Mobile Radio. The Commission adopted small business size standards for the purpose of determining eligibility for bidding credits in auctions of Specialized Mobile Radio (SMR) geographic area licenses in the 800 MHz and 900 MHz bands. The Commission defined a “small business” as an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$15 million for the preceding three years.¹⁰⁵ The Commission defined a “very small business” as an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$3 million for the preceding three years.¹⁰⁶ The SBA has approved these small business size standards for both the 800 MHz and 900 MHz SMR Service.¹⁰⁷ The first 900 MHz SMR auction was completed in 1996. Sixty bidders claiming that they qualified as small businesses under the \$15 million size standard won 263 licenses in the 900 MHz SMR band. In 2004, the Commission held a second auction of 900 MHz SMR licenses and three winning bidders identifying themselves as very small businesses won 7 licenses.¹⁰⁸ The auction of 800 MHz SMR licenses for the upper 200 channels was conducted in 1997. Ten bidders claiming that they qualified as small or very small businesses under the \$15 million size standard won 38 licenses for the upper 200 channels.¹⁰⁹ A second auction of 800 MHz SMR licenses was conducted in 2002 and included 23 BEA licenses. One bidder claiming small business status won five

⁹⁹ See *Service Rules for the 746-764 MHz Bands, and Revisions to Part 27 of the Commission’s Rules*, Second Report and Order, 15 FCC Rcd 5299 (2000) (“*700 MHz Guard Band Report and Order*”).

¹⁰⁰ See *700 MHz Guard Band Report and Order*, 15 FCC Rcd at 5343, para. 108.

¹⁰¹ See *id.*

¹⁰² See *id.*, 15 FCC Rcd 5299, 5343, para. 108 n.246 (for the 746-764 MHz and 776-794 MHz bands, the Commission is exempt from 15 U.S.C. § 632, which requires Federal agencies to obtain SBA approval before adopting small business size standards).

¹⁰³ See “700 MHz Guard Bands Auction Closes: Winning Bidders Announced,” *Public Notice*, 15 FCC Rcd 18026 (2000).

¹⁰⁴ See “700 MHz Guard Bands Auction Closes: Winning Bidders Announced,” *Public Notice*, 16 FCC Rcd 4590 (WTB 2001).

¹⁰⁵ 47 CFR §§ 90.810, 90.814(b), 90.912.

¹⁰⁶ 47 CFR §§ 90.810, 90.814(b), 90.912.

¹⁰⁷ See *Alvarez Letter 1999*.

¹⁰⁸ See 900 MHz Specialized Mobile Radio Service Spectrum Auction Closes: Winning Bidders Announced,” *Public Notice*, 19 FCC Rcd 3921 (WTB 2004).

¹⁰⁹ See “Correction to Public Notice DA 96-586 ‘FCC Announces Winning Bidders in the Auction of 1020 Licenses to Provide 900 MHz SMR in Major Trading Areas,’” *Public Notice*, 18 FCC Rcd 18367 (WTB 1996).

licenses.¹¹⁰

The auction of the 1,053 800 MHz SMR licenses for the General Category channels was conducted in 2000. Eleven bidders who won 108 licenses for the General Category channels in the 800 MHz SMR band qualified as small or very small businesses.¹¹¹ In an auction completed in 2000, a total of 2,800 Economic Area licenses in the lower 80 channels of the 800 MHz SMR service were awarded.¹¹² Of the 22 winning bidders, 19 claimed small or very small business status and won 129 licenses. Thus, combining all four auctions, 41 winning bidders for geographic licenses in the 800 MHz SMR band claimed to be small businesses.

In addition, there are numerous incumbent site-by-site SMR licensees and licensees with extended implementation authorizations in the 800 and 900 MHz bands. We do not know how many firms provide 800 MHz or 900 MHz geographic area SMR pursuant to extended implementation authorizations, nor how many of these providers have annual revenues not exceeding \$15 million. One firm has over \$15 million in revenues. In addition, we do not know how many of these firms have 1500 or fewer employees.¹¹³ We assume, for purposes of this analysis, that all of the remaining existing extended implementation authorizations are held by small entities, as that small business size standard is approved by the SBA.

220 MHz Radio Service – Phase I Licensees. The 220 MHz service has both Phase I and Phase II licenses. Phase I licensing was conducted by lotteries in 1992 and 1993. There are approximately 1,515 such non-nationwide licensees and four nationwide licensees currently authorized to operate in the 220 MHz band. The Commission has not developed a small business size standard for small entities specifically applicable to such incumbent 220 MHz Phase I licensees. To estimate the number of such licensees that are small businesses, the Commission applies the small business size standard under the SBA rules applicable. The SBA has deemed a wireless business to be small if it has 1,500 or fewer employees.¹¹⁴ For this service, the SBA uses the category of Wireless Telecommunications Carriers (except Satellite). Census data for 2007, which supersede data contained in the 2002 Census, show that there were 1,383 firms that operated that year.¹¹⁵ Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus under this category and the associated small business size standard, the majority of firms can be considered small.

220 MHz Radio Service – Phase II Licensees. The 220 MHz service has both Phase I and Phase II licenses. The Phase II 220 MHz service licenses are assigned by auction, where mutually exclusive applications are accepted. In the *220 MHz Third Report and Order*, the Commission adopted a small business size standard for defining “small” and “very small” businesses for purposes of determining their

¹¹⁰ See “Multi-Radio Service Auction Closes,” *Public Notice*, 17 FCC Rcd 1446 (WTB 2002).

¹¹¹ See “800 MHz Specialized Mobile Radio (SMR) Service General Category (851-854 MHz) and Upper Band (861-865 MHz) Auction Closes; Winning Bidders Announced,” *Public Notice*, 15 FCC Rcd 17162 (2000).

¹¹² See, “800 MHz SMR Service Lower 80 Channels Auction Closes; Winning Bidders Announced,” *Public Notice*, 16 FCC Rcd 1736 (2000).

¹¹³ See generally 13 CFR § 121.201, NAICS code 517210.

¹¹⁴ 13 CFR § 121.201, NAICS code 517210 (2007 NAICS). The now-superseded, pre-2007 CFR citations were 13 CFR § 121.201, NAICS codes 517211 and 517212 (referring to the 2002 NAICS).

¹¹⁵ U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-skip=700&-ds_name=EC0751SSSZ5&-lang=en.

eligibility for special provisions such as bidding credits.¹¹⁶ This small business standard indicates that a “small business” is an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$15 million for the preceding three years.¹¹⁷ A “very small business” is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues that do not exceed \$3 million for the preceding three years.¹¹⁸ The SBA has approved these small size standards.¹¹⁹ Auctions of Phase II licenses commenced on and closed in 1998.¹²⁰ In the first auction, 908 licenses were auctioned in three different sized geographic areas: three nationwide licenses, 30 Regional Economic Area Group (EAG) Licenses, and 875 Economic Area (EA) Licenses. Of the 908 licenses auctioned, 693 were sold.¹²¹ Thirty-nine small businesses won 373 licenses in the first 220 MHz auction. A second auction included 225 licenses: 216 EA licenses and 9 EAG licenses. Fourteen companies claiming small business status won 158 licenses.¹²² A third auction included four licenses: 2 BEA licenses and 2 EAG licenses in the 220 MHz Service. No small or very small business won any of these licenses.¹²³ In 2007, the Commission conducted a fourth auction of the 220 MHz licenses, designated as Auction 72.¹²⁴ Auction 72, which offered 94 Phase II 220 MHz Service licenses, concluded in 2007.¹²⁵ In this auction, five winning bidders won a total of 76 licenses. Two winning bidders identified themselves as very small businesses won 56 of the 76 licenses. One of the winning bidders that identified themselves as a small business won 5 of the 76 licenses won.

Private Land Mobile Radio (“PLMR”). PLMR systems serve an essential role in a range of industrial, business, land transportation, and public safety activities. These radios are used by companies of all sizes operating in all U.S. business categories, and are often used in support of the licensee’s primary (non-telecommunications) business operations. For the purpose of determining whether a licensee of a PLMR system is a small business as defined by the SBA, we use the broad census category, Wireless Telecommunications Carriers (except Satellite). This definition provides that a small entity is any such entity employing no more than 1,500 persons.¹²⁶ The Commission does not require PLMR licensees to disclose information about number of employees, so the Commission does not have information that could be used to determine how many PLMR licensees constitute small entities under this definition. We note that PLMR licensees generally use the licensed facilities in support of other business activities, and

¹¹⁶ *Amendment of Part 90 of the Commission’s Rules to Provide for the Use of the 220-222 MHz Band by the Private Land Mobile Radio Service*, Third Report and Order, 12 FCC Rcd 10943, 11068-70 ¶¶ 291-295 (1997).

¹¹⁷ *Id.* at 11068 ¶ 291.

¹¹⁸ *Id.*

¹¹⁹ See Letter to Daniel Phythyon, Chief, Wireless Telecommunications Bureau, Federal Communications Commission, from Aida Alvarez, Administrator, Small Business Administration, dated January 6, 1998 (*Alvarez to Phythyon Letter 1998*).

¹²⁰ See generally *220 MHz Service Auction Closes*, Public Notice, 14 FCC Rcd 605 (WTB 1998).

¹²¹ See *FCC Announces It is Prepared to Grant 654 Phase II 220 MHz Licenses After Final Payment is Made*, Public Notice, 14 FCC Rcd 1085 (WTB 1999).

¹²² See *Phase II 220 MHz Service Spectrum Auction Closes*, Public Notice, 14 FCC Rcd 11218 (WTB 1999).

¹²³ See *Multi-Radio Service Auction Closes*, Public Notice, 17 FCC Rcd 1446 (WTB 2002).

¹²⁴ See “Auction of Phase II 220 MHz Service Spectrum Scheduled for June 20, 2007, Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments and Other Procedures for Auction 72, *Public Notice*, 22 FCC Rcd 3404 (2007).

¹²⁵ See *Auction of Phase II 220 MHz Service Spectrum Licenses Closes, Winning Bidders Announced for Auction 72, Down Payments due July 18, 2007, FCC Forms 601 and 602 due July 18, 2007, Final Payments due August 1, 2007, Ten-Day Petition to Deny Period*, Public Notice, 22 FCC Rcd 11573 (2007).

¹²⁶ See 13 CFR § 121.201, NAICS code 517210.

therefore, it would also be helpful to assess PLMR licensees under the standards applied to the particular industry subsector to which the licensee belongs.¹²⁷

As of March 2010, there were 424,162 PLMR licensees operating 921,909 transmitters in the PLMR bands below 512 MHz. We note that any entity engaged in a commercial activity is eligible to hold a PLMR license, and that any revised rules in this context could therefore potentially impact small entities covering a great variety of industries.

Fixed Microwave Services. Microwave services include common carrier,¹²⁸ private-operational fixed,¹²⁹ and broadcast auxiliary radio services.¹³⁰ They also include the Local Multipoint Distribution Service (LMDS),¹³¹ the Digital Electronic Message Service (DEMS),¹³² and the 24 GHz Service,¹³³ where licensees can choose between common carrier and non-common carrier status.¹³⁴ At present, there are approximately 36,708 common carrier fixed licensees and 59,291 private operational-fixed licensees and broadcast auxiliary radio licensees in the microwave services. There are approximately 135 LMDS licensees, three DEMS licensees, and three 24 GHz licensees. The Commission has not yet defined a small business with respect to microwave services. The closest applicable SBA category is Wireless Telecommunications Carriers (except Satellite) and the appropriate size standard for this category under SBA rules is that such a business is small if it has 1,500 or fewer employees.¹³⁵ For this industry, U.S. Census data for 2012 shows that there were 967 firms that operated for the entire year.¹³⁶ Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.¹³⁷ Thus under this SBA category and the associated size standard, the Commission estimates that a majority of fixed microwave service licensees can be considered small.

The Commission does not have data specifying the number of these licensees that have more than 1,500 employees, and thus is unable at this time to estimate with greater precision the number of fixed microwave service licensees that would qualify as small business concerns under the SBA's small business size standard. Consequently, the Commission estimates that there are up to 36,708 common carrier fixed licensees and up to 59,291 private operational-fixed licensees and broadcast auxiliary radio licensees in the microwave services that may be small and may be affected by the rules and policies

¹²⁷ See generally 13 CFR § 121.201.

¹²⁸ See 47 CFR Part 101, Subparts C and I.

¹²⁹ See 47 CFR Part 101, Subparts C and H.

¹³⁰ Auxiliary Microwave Service is governed by Part 74 of Title 47 of the Commission's Rules. See 47 CFR Part 74. Available to licensees of broadcast stations and to broadcast and cable network entities, broadcast auxiliary microwave stations are used for relaying broadcast television signals from the studio to the transmitter, or between two points such as a main studio and an auxiliary studio. The service also includes mobile TV pickups, which relay signals from a remote location back to the studio.

¹³¹ See 47 CFR Part 101, Subpart L.

¹³² See 47 CFR Part 101, Subpart G.

¹³³ See *id.*

¹³⁴ See 47 CFR §§ 101.533, 101.1017.

¹³⁵ See 13 CFR § 121.201, NAICS code 517210.

¹³⁶ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, Information: Subject Series, "Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210" (rel. Jan. 8, 2016). https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~517210.

¹³⁷ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with "1000 employees or more."

adopted herein. We note, however, that the common carrier microwave fixed licensee category does include some large entities.

39 GHz Service. The Commission adopted small business size standards for 39 GHz licenses. A “small business” is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$40 million in the preceding three years.¹³⁸ A “very small business” is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues of not more than \$15 million for the preceding three years.¹³⁹ The SBA has approved these small business size standards.¹⁴⁰ In 2000, the Commission conducted an auction of 2,173 39 GHz licenses. A total of 18 bidders who claimed small or very small business status won 849 licenses.

Local Multipoint Distribution Service. Local Multipoint Distribution Service (“LMDS”) is a fixed broadband point-to-multipoint microwave service that provides for two-way video telecommunications.¹⁴¹ The Commission established a small business size standard for LMDS licenses as an entity that has average gross revenues of less than \$40 million in the three previous years.¹⁴² An additional small business size standard for “very small business” was added as an entity that, together with its affiliates, has average gross revenues of not more than \$15 million for the preceding three years.¹⁴³ The SBA has approved these small business size standards in the context of LMDS auctions.¹⁴⁴ There were 93 winning bidders that qualified as small entities in the LMDS auctions. A total of 93 small and very small business bidders won approximately 277 A Block licenses and 387 B Block licenses. In 1999, the Commission re-auctioned 161 licenses; there were 32 small and very small businesses winning that won 119 licenses.

218-219 MHz Service. The first auction of 218-219 MHz Service (previously referred to as the Interactive and Video Data Service or IVDS) licenses resulted in 170 entities winning licenses for 594 Metropolitan Statistical Areas (“MSAs”).¹⁴⁵ Of the 594 licenses, 557 were won by 167 entities qualifying as a small business. For that auction, the Commission defined a small business as an entity that, together with its affiliates, has no more than a \$6 million net worth and, after federal income taxes (excluding any carry over losses), has no more than \$2 million in annual profits each year for the previous two years.¹⁴⁶ In the *218-219 MHz Report and Order and Memorandum Opinion and Order*, the Commission revised its small business size standards for the 218-219 MHz Service and defined a small business as an entity that, together with its affiliates and persons or entities that hold interests in such an entity and their affiliates,

¹³⁸ See *Amendment of the Commission’s Rules Regarding the 37.0-38.6 GHz and 38.6-40.0 GHz Bands*, ET Docket No. 95-183, Report and Order, 12 FCC Rcd 18600 (1997).

¹³⁹ *Id.*

¹⁴⁰ See Letter from Aida Alvarez, Administrator, SBA, to Kathleen O’Brien Ham, Chief, Auctions and Industry Analysis Division, WTB, FCC (Feb. 4, 1998); see Letter from Hector Barreto, Administrator, SBA, to Margaret Wiener, Chief, Auctions and Industry Analysis Division, WTB, FCC (Jan. 18, 2002).

¹⁴¹ See [Rulemaking to Amend Parts 1, 2, 21, 25, of the Commission’s Rules to Redesignate the 27.5-29.5 GHz Frequency Band, Reallocate the 29.5-30.5 Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services](#), CC Docket No. 92-297, Second Report and Order, Order on Reconsideration, and Fifth Notice of Proposed Rule Making, 12 FCC Rcd 12545, 12689-90, para. 348 (1997) (“LMDS Second Report and Order”).

¹⁴² See [LMDS Second Report and Order](#), 12 FCC Rcd at 12689-90, para. 348.

¹⁴³ See *id.*

¹⁴⁴ See Alvarez to Phythyon Letter 1998.

¹⁴⁵ See “Interactive Video and Data Service (IVDS) Applications Accepted for Filing,” Public Notice, 9 FCC Rcd 6227 (1994).

¹⁴⁶ *Implementation of Section 309(j) of the Communications Act – Competitive Bidding*, Fourth Report and Order, 9 FCC Rcd 2330 (1994).

has average annual gross revenues not exceeding \$15 million for the preceding three years.¹⁴⁷ The Commission defined a “very small business” as an entity that, together with its affiliates and persons or entities that hold interests in such an entity and its affiliates, has average annual gross revenues not exceeding \$3 million for the preceding three years.¹⁴⁸ The SBA has approved these definitions.¹⁴⁹

Location and Monitoring Service (“LMS”). Multilateration LMS systems use non-voice radio techniques to determine the location and status of mobile radio units. For auctions of LMS licenses, the Commission has defined a “small business” as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the preceding three years not exceeding \$15 million.¹⁵⁰ A “very small business” is defined as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the preceding three years not exceeding \$3 million.¹⁵¹ These definitions have been approved by the SBA.¹⁵² An auction of LMS licenses was conducted in 1999. Of the 528 licenses auctioned, 289 licenses were sold to four small businesses.

Rural Radiotelephone Service. The Commission has not adopted a size standard for small businesses specific to the Rural Radiotelephone Service.¹⁵³ A significant subset of the Rural Radiotelephone Service is the Basic Exchange Telephone Radio System (“BETRS”).¹⁵⁴ For purposes of its analysis of the Rural Radiotelephone Service, the Commission uses the SBA small business size standard for the category “Wireless Telecommunications Carriers (except satellite),” which is 1,500 or fewer employees.¹⁵⁵ Census data for 2007 shows that there were 1,383 firms that operated that year.¹⁵⁶ Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus under this category and the associated small business size standard, the majority of firms in the Rural Radiotelephone Service can be considered small.

Air-Ground Radiotelephone Service.¹⁵⁷ The Commission has previously used the SBA’s small business definition applicable to Wireless Telecommunications Carriers (except Satellite), *i.e.*, an entity employing no more than 1,500 persons.¹⁵⁸ There are approximately 100 licensees in the Air-Ground Radiotelephone Service, and under that definition, we estimate that almost all of them qualify as small entities under the SBA definition. For purposes of assigning Air-Ground Radiotelephone Service licenses through competitive bidding, the Commission has defined “small business” as an entity that, together

¹⁴⁷ *Amendment of Part 95 of the Commission’s Rules to Provide Regulatory Flexibility in the 218-219 MHz Service*, Report and Order and Memorandum Opinion and Order, 15 FCC Rcd 1497 (1999).

¹⁴⁸ *Id.*

¹⁴⁹ *See Alvarez to Phythyon Letter 1998.*

¹⁵⁰ *Amendment of Part 90 of the Commission’s Rules to Adopt Regulations for Automatic Vehicle Monitoring Systems*, Second Report and Order, 13 FCC Rcd 15182, 15192, ¶ 20 (1998) (“*Automatic Vehicle Monitoring Systems Second Report and Order*”); *see also* 47 CFR § 90.1103.

¹⁵¹ *Automatic Vehicle Monitoring Systems Second Report and Order*, 13 FCC Rcd at 15192, para. 20; *see also* 47 CFR § 90.1103.

¹⁵² *See Alvarez Letter 1998.*

¹⁵³ The service is defined in section 22.99 of the Commission’s Rules, 47 CFR § 22.99.

¹⁵⁴ BETRS is defined in sections 22.757 and 22.759 of the Commission’s Rules, 47 CFR §§ 22.757 and 22.759.

¹⁵⁵ 13 CFR § 121.201, NAICS code 517210.

¹⁵⁶ U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-_skip=700&-ds_name=EC0751SSSZ5&-lang=en.

¹⁵⁷ The service is defined in § 22.99 of the Commission’s Rules, 47 CFR § 22.99.

¹⁵⁸ 13 CFR § 121.201, NAICS codes 517210.

with controlling interests and affiliates, has average annual gross revenues for the preceding three years not exceeding \$40 million.¹⁵⁹ A “very small business” is defined as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the preceding three years not exceeding \$15 million.¹⁶⁰ These definitions were approved by the SBA.¹⁶¹ In 2006, the Commission completed an auction of nationwide commercial Air-Ground Radiotelephone Service licenses in the 800 MHz band (Auction 65). The auction closed with two winning bidders winning two Air-Ground Radiotelephone Services licenses. Neither of the winning bidders claimed small business status.

Aviation and Marine Radio Services. Small businesses in the aviation and marine radio services use a very high frequency (“VHF”) marine or aircraft radio and, as appropriate, an emergency position-indicating radio beacon (and/or radar) or an emergency locator transmitter. The Commission has not developed a small business size standard specifically applicable to these small businesses. For purposes of this analysis, the Commission uses the SBA small business size standard for the category Wireless Telecommunications Carriers (except satellite),” which is 1,500 or fewer employees.¹⁶² Census data for 2007 shows that there were 1,383 firms that operated that year.¹⁶³ Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus, under this category and the associated small business size standard, the majority of firms can be considered small.

Offshore Radiotelephone Service. This service operates on several UHF television broadcast channels that are not used for television broadcasting in the coastal areas of states bordering the Gulf of Mexico.¹⁶⁴ There are presently approximately 55 licensees in this service. The Commission is unable to estimate at this time the number of licensees that would qualify as small under the SBA’s small business size standard for the category of Wireless Telecommunications Carriers (except Satellite). Under that standard.¹⁶⁵ Under that SBA small business size standard, a business is small if it has 1,500 or fewer employees.¹⁶⁶ Census data for 2007 shows that there were 1,383 firms that operated that year.¹⁶⁷ Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus, under this category and the associated small business size standard, the majority of firms can be considered small.

Multiple Address Systems (“MAS”). Entities using MAS spectrum, in general, fall into two categories: (1) those using the spectrum for profit-based uses, and (2) those using the spectrum for private internal uses. The Commission defines a small business for MAS licenses as an entity that has average gross

¹⁵⁹ *Amendment of Part 22 of the Commission’s Rules to Benefit the Consumers of Air-Ground Telecommunications Services, Biennial Regulatory Review – Amendment of Parts 1, 22, and 90 of the Commission’s Rules, Amendment of Parts 1 and 22 of the Commission’s Rules to Adopt Competitive Bidding Rules for Commercial and General Aviation Air-Ground Radiotelephone Service*, WT Docket Nos. 03-103 and 05-42, Order on Reconsideration and Report and Order, 20 FCC Rcd 19663, ¶¶ 28-42 (2005).

¹⁶⁰ *Id.*

¹⁶¹ See Letter from Hector V. Barreto, Administrator, SBA, to Gary D. Michaels, Deputy Chief, Auctions and Spectrum Access Division, WTB, FCC (Sept. 19, 2005).

¹⁶² 13 CFR § 121.201, NAICS code 517210.

¹⁶³ U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-skip=700&-ds_name=EC0751SSSZ5&-lang=en.

¹⁶⁴ This service is governed by Subpart I of Part 22 of the Commission’s Rules. See 47 CFR §§ 22.1001-22.1037.

¹⁶⁵ 13 CFR § 121.201, NAICS code 517210.

¹⁶⁶ *Id.*

¹⁶⁷ U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-skip=700&-ds_name=EC0751SSSZ5&-lang=en.

revenues of less than \$15 million in the preceding three years.¹⁶⁸ A very small business is defined as an entity that, together with its affiliates, has average gross revenues of not more than \$3 million for the preceding three years.¹⁶⁹ The SBA has approved these definitions.¹⁷⁰ The majority of these entities will most likely be licensed in bands where the Commission has implemented a geographic area licensing approach that would require the use of competitive bidding procedures to resolve mutually exclusive applications. The Commission's licensing database indicates that, as of March 5, 2010, there were over 11,500 MAS station authorizations. In 2001, an auction of 5,104 MAS licenses in 176 EAs was conducted.¹⁷¹ Seven winning bidders claimed status as small or very small businesses and won 611 licenses. In 2005, the Commission completed an auction (Auction 59) of 4,226 MAS licenses in the Fixed Microwave Services from the 928/959 and 932/941 MHz bands. Twenty-six winning bidders won a total of 2,323 licenses. Of the 26 winning bidders in this auction, five claimed small business status and won 1,891 licenses.

With respect to entities that use, or seek to use, MAS spectrum to accommodate internal communications needs, we note that MAS serves an essential role in a range of industrial, safety, business, and land transportation activities. MAS radios are used by companies of all sizes, operating in virtually all U.S. business categories, and by all types of public safety entities. For the majority of private internal users, the small business size standard developed by the SBA would be more appropriate. The applicable size standard in this instance appears to be that of Wireless Telecommunications Carriers (except Satellite). This definition provides that a small entity is any such entity employing no more than 1,500 persons.¹⁷² The Commission's licensing database indicates that, as of January 20, 1999, of the 8,670 total MAS station authorizations, 8,410 authorizations were for private radio service, and of these, 1,433 were for private land mobile radio service.

1.4 GHz Band Licensees. The Commission conducted an auction of 64 1.4 GHz band licenses in the paired 1392-1395 MHz and 1432-1435 MHz bands, and in the unpaired 1390-1392 MHz band in 2007.¹⁷³ For these licenses, the Commission defined "small business" as an entity that, together with its affiliates and controlling interests, had average gross revenues not exceeding \$40 million for the preceding three years, and a "very small business" as an entity that, together with its affiliates and controlling interests, has had average annual gross revenues not exceeding \$15 million for the preceding three years.¹⁷⁴ Neither of the two winning bidders claimed small business status.¹⁷⁵

Incumbent 24 GHz Licensees. This analysis may affect incumbent licensees who were relocated to the 24 GHz band from the 18 GHz band, and applicants who wish to provide services in the 24 GHz band. For this service, the Commission uses the SBA small business size standard for the category "Wireless Telecommunications Carriers (except satellite)," which is 1,500 or fewer employees.¹⁷⁶ To gauge small

¹⁶⁸ See *Amendment of the Commission's Rules Regarding Multiple Address Systems*, Report and Order, 15 FCC Rcd 11956, 12008, ¶ 123 (2000).

¹⁶⁹ *Id.*

¹⁷⁰ See *Alvarez Letter 1999*.

¹⁷¹ See "Multiple Address Systems Spectrum Auction Closes," Public Notice, 16 FCC Rcd 21011 (2001).

¹⁷² See 13 CFR § 121.201, NAICS code 517210.

¹⁷³ See "Auction of 1.4 GHz Band Licenses Scheduled for February 7, 2007," Public Notice, 21 FCC Rcd 12393 (WTB 2006); "Auction of 1.4 GHz Band Licenses Closes; Winning Bidders Announced for Auction No. 69," Public Notice, 22 FCC Rcd 4714 (2007) ("Auction No. 69 Closing PN").

¹⁷⁴ *Auction No. 69 Closing PN*, Attachment C.

¹⁷⁵ See *Auction No. 69 Closing PN*.

¹⁷⁶ 13 CFR § 121.201, NAICS code 517210.

business prevalence for these cable services we must, however, use the most current census data. Census data for 2007 shows that there were 1,383 firms that operated that year.¹⁷⁷ Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus, under this category and the associated small business size standard, the majority of firms can be considered small. The Commission notes that the Census' use of the classifications "firms" does not track the number of "licenses". The Commission believes that there are only two licensees in the 24 GHz band that were relocated from the 18 GHz band, Teligent¹⁷⁸ and TRW, Inc. It is our understanding that Teligent and its related companies have less than 1,500 employees, though this may change in the future. TRW is not a small entity. Thus, only one incumbent licensee in the 24 GHz band is a small business entity.

Future 24 GHz Licensees. With respect to new applicants for licenses in the 24 GHz band, for the purpose of determining eligibility for bidding credits, the Commission established three small business definitions. An "entrepreneur" is defined as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the three preceding years not exceeding \$40 million.¹⁷⁹ A "small business" is defined as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the three preceding years not exceeding \$15 million.¹⁸⁰ A "very small business" in the 24 GHz band is defined as an entity that, together with controlling interests and affiliates, has average gross revenues not exceeding \$3 million for the preceding three years.¹⁸¹ The SBA has approved these small business size standards.¹⁸² In a 2004 auction of 24 GHz licenses, three winning bidders won seven licenses.¹⁸³ Two of the winning bidders were very small businesses that won five licenses.

Broadband Radio Service and Educational Broadband Service. Broadband Radio Service systems, previously referred to as Multipoint Distribution Service ("MDS") and Multichannel Multipoint Distribution Service ("MMDS") systems, and "wireless cable," transmit video programming to subscribers and provide two-way high speed data operations using the microwave frequencies of the Broadband Radio Service ("BRS") and Educational Broadband Service ("EBS") (previously referred to as the Instructional Television Fixed Service ("ITFS")).¹⁸⁴ In connection with the 1996 BRS auction, the Commission established a small business size standard as an entity that had annual average gross

¹⁷⁷ U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-skip=700&-ds_name=EC0751SSSZ5&-lang=en.

¹⁷⁸ Teligent acquired the DEMS licenses of FirstMark, the only licensee other than TRW in the 24 GHz band whose license has been modified to require relocation to the 24 GHz band.

¹⁷⁹ *Amendments to Parts 1, 2, 87 and 101 of the Commission's Rules to License Fixed Services at 24 GHz*, Report and Order, 15 FCC Rcd 16934, 16967 ¶ 77 (2000) ("24 GHz Report and Order"); see also 47 CFR § 101.538(a)(3).

¹⁸⁰ *24 GHz Report and Order*, 15 FCC Rcd at 16967 ¶ 77; see also 47 CFR § 101.538(a)(2).

¹⁸¹ *24 GHz Report and Order*, 15 FCC Rcd at 16967 ¶ 77; see also 47 CFR § 101.538(a)(1).

¹⁸² See Letter to Margaret W. Wiener, Deputy Chief, Auctions and Industry Analysis Division, Wireless Telecommunications Bureau, FCC, from Gary M. Jackson, Assistant Administrator, SBA (July 28, 2000).

¹⁸³ *Auction of 24 GHz Service Spectrum Auction Closes, Winning Bidders Announced for Auction 56, Down Payments Due August 16, 2004, Final Payments Due August 30, 2004, Ten-Day Petition to Deny Period*, Public Notice, 19 FCC Rcd 14738 (2004).

¹⁸⁴ *Amendment of Parts 21 and 74 of the Commission's Rules with Regard to Filing Procedures in the Multipoint Distribution Service and in the Instructional Television Fixed Service and Implementation of Section 309(j) of the Communications Act—Competitive Bidding*, MM Docket No. 94-131, PP Docket No. 93-253, Report and Order, 10 FCC Rcd 9589, 9593 ¶ 7 (1995).

revenues of no more than \$40 million in the previous three years.¹⁸⁵ The BRS auctions resulted in 67 successful bidders obtaining licensing opportunities for 493 Basic Trading Areas (“BTAs”). Of the 67 auction winners, 61 met the definition of a small business. BRS also includes licensees of stations authorized prior to the auction. At this time, we estimate that of the 61 small business BRS auction winners, 48 remain small business licensees. In addition to the 48 small businesses that hold BTA authorizations, there are approximately 392 incumbent BRS licensees that are considered small entities.¹⁸⁶ After adding the number of small business auction licensees to the number of incumbent licensees not already counted, we find that there are currently approximately 440 BRS licensees that are defined as small businesses under either the SBA or the Commission’s rules. In 2009, the Commission conducted Auction 86, the sale of 78 licenses in the BRS areas.¹⁸⁷ The Commission offered three levels of bidding credits: (i) a bidder with attributed average annual gross revenues that exceed \$15 million and do not exceed \$40 million for the preceding three years (small business) will receive a 15 percent discount on its winning bid; (ii) a bidder with attributed average annual gross revenues that exceed \$3 million and do not exceed \$15 million for the preceding three years (very small business) will receive a 25 percent discount on its winning bid; and (iii) a bidder with attributed average annual gross revenues that do not exceed \$3 million for the preceding three years (entrepreneur) will receive a 35 percent discount on its winning bid.¹⁸⁸ Auction 86 concluded in 2009 with the sale of 61 licenses.¹⁸⁹ Of the ten winning bidders, two bidders that claimed small business status won 4 licenses; one bidder that claimed very small business status won three licenses; and two bidders that claimed entrepreneur status won six licenses.

In addition, the SBA’s Cable Television Distribution Services small business size standard is applicable to EBS. There are presently 2,032 EBS licensees. All but 100 of these licenses are held by educational institutions. Educational institutions are included in this analysis as small entities.¹⁹⁰ Thus, we estimate that at least 1,932 licensees are small businesses. Since 2007, Cable Television Distribution Services have been defined within the broad economic census category of Wired Telecommunications Carriers; that category is defined as follows: “This industry comprises establishments primarily engaged in operating and/or providing access to transmission facilities and infrastructure that they own and/or lease for the transmission of voice, data, text, sound, and video using wired telecommunications networks. Transmission facilities may be based on a single technology or a combination of technologies.”¹⁹¹ For these services, the Commission uses the SBA small business size standard for the category “Wireless Telecommunications Carriers (except satellite),” which is 1,500 or fewer employees.¹⁹² To gauge small

¹⁸⁵ 47 CFR § 21.961(b)(1).

¹⁸⁶ 47 U.S.C. § 309(j). Hundreds of stations were licensed to incumbent MDS licensees prior to implementation of Section 309(j) of the Communications Act of 1934, 47 U.S.C. § 309(j). For these pre-auction licenses, the applicable standard is SBA’s small business size standard of 1500 or fewer employees.

¹⁸⁷ *Auction of Broadband Radio Service (BRS) Licenses, Scheduled for October 27, 2009, Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments, and Other Procedures for Auction 86*, Public Notice, 24 FCC Rcd 8277 (2009).

¹⁸⁸ *Id.* at 8296.

¹⁸⁹ *Auction of Broadband Radio Service Licenses Closes, Winning Bidders Announced for Auction 86, Down Payments Due November 23, 2009, Final Payments Due December 8, 2009, Ten-Day Petition to Deny Period*, Public Notice, 24 FCC Rcd 13572 (2009).

¹⁹⁰ The term “small entity” within SBREFA applies to small organizations (nonprofits) and to small governmental jurisdictions (cities, counties, towns, townships, villages, school districts, and special districts with populations of less than 50,000). 5 U.S.C. §§ 601(4)–(6). We do not collect annual revenue data on EBS licensees.

¹⁹¹ U.S. Census Bureau, 2007 NAICS Definitions, 517110 Wired Telecommunications Carriers, (partial definition), <http://www.census.gov/naics/2007/def/ND517110.HTM#N517110>.

¹⁹² 13 CFR § 121.201, NAICS code 517210.

business prevalence for these cable services we must, however, use the most current census data. According to Census Bureau data for 2007, there were a total of 955 firms in this previous category that operated for the entire year.¹⁹³ Of this total, 939 firms employed 999 or fewer employees, and 16 firms employed 1,000 employees or more.¹⁹⁴ Thus, the majority of these firms can be considered small.

Television Broadcasting. This Economic Census category “comprises establishments primarily engaged in broadcasting images together with sound. These establishments operate television broadcasting studios and facilities for the programming and transmission of programs to the public.”¹⁹⁵ The SBA has created the following small business size standard for Television Broadcasting firms: those having \$14 million or less in annual receipts.¹⁹⁶ The Commission has estimated the number of licensed commercial television stations to be 1,387.¹⁹⁷ In addition, according to Commission staff review of the BIA Advisory Services, LLC’s *Media Access Pro Television Database* on March 28, 2012, about 950 of an estimated 1,300 commercial television stations (or approximately 73 percent) had revenues of \$14 million or less.¹⁹⁸ We therefore estimate that the majority of commercial television broadcasters are small entities.

We note, however, that in assessing whether a business concern qualifies as small under the above definition, business (control) affiliations¹⁹⁹ must be included. Our estimate, therefore, likely overstates the number of small entities that might be affected by our action because the revenue figure on which it is based does not include or aggregate revenues from affiliated companies. In addition, an element of the definition of “small business” is that the entity not be dominant in its field of operation. We are unable at this time to define or quantify the criteria that would establish whether a specific television station is dominant in its field of operation. Accordingly, the estimate of small businesses to which rules may apply does not exclude any television station from the definition of a small business on this basis and is therefore possibly over-inclusive to that extent.

In addition, the Commission has estimated the number of licensed noncommercial educational (NCE) television stations to be 396.²⁰⁰ These stations are non-profit, and therefore considered to be small entities.²⁰¹

In addition, there are also 2,528 low power television stations, including Class A stations (LPTV).²⁰² Given the nature of these services, we will presume that all LPTV licensees qualify as small entities under the above SBA small business size standard.

¹⁹³ U.S. Census Bureau, 2007 Economic Census, Subject Series: Information, Table 5, Employment Size of Firms for the United States: 2007, NAICS code 5171102 (issued November 2010).

¹⁹⁴ *Id.*

¹⁹⁵ U.S. Census Bureau, 2007 NAICS Definitions, “515120 Television Broadcasting” (partial definition); <http://www.census.gov/naics/2007/def/ND515120.HTM#N515120>.

¹⁹⁶ 13 CFR § 121.201, NAICS code 515120 (updated for inflation in 2010).

¹⁹⁷ See *FCC News Release*, “Broadcast Station Totals as of December 31, 2011,” dated January 6, 2012; http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-311837A1.pdf.

¹⁹⁸ We recognize that BIA’s estimate differs slightly from the FCC total given.

¹⁹⁹ “[Business concerns] are affiliates of each other when one concern controls or has the power to control the other or a third party or parties controls or has to power to control both.” 13 CFR § 21.103(a)(1).

²⁰⁰ See *FCC News Release*, “Broadcast Station Totals as of December 31, 2011,” dated January 6, 2012; http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0106/DOC-311837A1.pdf.

²⁰¹ See generally 5 U.S.C. §§ 601(4), (6).

²⁰² See *FCC News Release*, “Broadcast Station Totals as of December 31, 2011,” dated January 6, 2012; http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0106/DOC-311837A1.pdf.

Radio Broadcasting. This Economic Census category “comprises establishments primarily engaged in broadcasting aural programs by radio to the public. Programming may originate in their own studio, from an affiliated network, or from external sources.”²⁰³ The SBA has established a small business size standard for this category, which is: such firms having \$7 million or less in annual receipts.²⁰⁴ According to Commission staff review of BIA Advisory Services, LLC’s *Media Access Pro Radio Database* on March 28, 2012, about 10,759 (97%) of 11,102 commercial radio stations had revenues of \$7 million or less. Therefore, the majority of such entities are small entities.

We note, however, that in assessing whether a business concern qualifies as small under the above size standard, business affiliations must be included.²⁰⁵ In addition, to be determined to be a “small business,” the entity may not be dominant in its field of operation.²⁰⁶ We note that it is difficult at times to assess these criteria in the context of media entities, and our estimate of small businesses may therefore be over-inclusive.

Auxiliary, Special Broadcast and Other Program Distribution Services. This service involves a variety of transmitters, generally used to relay broadcast programming to the public (through translator and booster stations) or within the program distribution chain (from a remote news gathering unit back to the station). The Commission has not developed a definition of small entities applicable to broadcast auxiliary licensees. The applicable definitions of small entities are those, noted previously, under the SBA rules applicable to radio broadcasting stations and television broadcasting stations.²⁰⁷

The Commission estimates that there are approximately 6,099 FM translators and boosters.²⁰⁸ The Commission does not collect financial information on any broadcast facility, and the Department of Commerce does not collect financial information on these auxiliary broadcast facilities. We believe that most, if not all, of these auxiliary facilities could be classified as small businesses by themselves. We also recognize that most commercial translators and boosters are owned by a parent station which, in some cases, would be covered by the revenue definition of small business entity discussed above. These stations would likely have annual revenues that exceed the SBA maximum to be designated as a small business (\$7.0 million for a radio station or \$14.0 million for a TV station). Furthermore, they do not meet the Small Business Act’s definition of a “small business concern” because they are not independently owned and operated.²⁰⁹

Multichannel Video Distribution and Data Service. MVDDS is a terrestrial fixed microwave service operating in the 12.2-12.7 GHz band. The Commission adopted criteria for defining three groups of small businesses for purposes of determining their eligibility for special provisions such as bidding credits. It defines a very small business as an entity with average annual gross revenues not exceeding \$3 million

²⁰³ U.S. Census Bureau, 2007 NAICS Definitions, “515112 Radio Stations”; <http://www.census.gov/naics/2007/def/ND515112.HTM#N515112>.

²⁰⁴ 13 CFR § 121.201, NAICS code 515112 (updated for inflation in 2010).

²⁰⁵ “Concerns and entities are affiliates of each other when one controls or has the power to control the other, or a third party or parties controls or has the power to control both. It does not matter whether control is exercised, so long as the power to control exists.” 13 CFR § 121.103(a)(1) (an SBA regulation).

²⁰⁶ 13 CFR § 121.102(b) (an SBA regulation).

²⁰⁷ 13 CFR 121.201, NAICS codes 515112 and 515120.

²⁰⁸ See *FCC News Release*, “Broadcast Station Totals as of December 31, 2011,” dated January 6, 2012; http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0106/DOC-311837A1.pdf.

²⁰⁹ See 15 U.S.C. § 632.

for the preceding three years; a small business as an entity with average annual gross revenues not exceeding \$15 million for the preceding three years; and an entrepreneur as an entity with average annual gross revenues not exceeding \$40 million for the preceding three years.²¹⁰ These definitions were approved by the SBA.²¹¹ On January 27, 2004, the Commission completed an auction of 214 MVDDS licenses (Auction No. 53). In this auction, ten winning bidders won a total of 192 MVDDS licenses.²¹² Eight of the ten winning bidders claimed small business status and won 144 of the licenses. The Commission also held an auction of MVDDS licenses on December 7, 2005 (Auction 63). Of the three winning bidders who won 22 licenses, two winning bidders, winning 21 of the licenses, claimed small business status.²¹³

Amateur Radio Service. These licensees are held by individuals in a noncommercial capacity; these licensees are not small entities.

Personal Radio Services. Personal radio services provide short-range, low power radio for personal communications, radio signaling, and business communications not provided for in other services. The Personal Radio Services include spectrum licensed under Part 95 of our rules.²¹⁴ These services include Citizen Band Radio Service (“CB”), General Mobile Radio Service (“GMRS”), Radio Control Radio Service (“R/C”), Family Radio Service (“FRS”), Wireless Medical Telemetry Service (“WMTS”), Medical Implant Communications Service (“MICS”), Low Power Radio Service (“LPRS”), and Multi-Use Radio Service (“MURS”).²¹⁵ There are a variety of methods used to license the spectrum in these rule parts, from licensing by rule, to conditioning operation on successful completion of a required test, to site-based licensing, to geographic area licensing. Under the RFA, the Commission is required to make a determination of which small entities are directly affected by the rules being proposed. Since all such entities are wireless, we apply the definition of Wireless Telecommunications Carriers (except Satellite), pursuant to which a small entity is defined as employing 1,500 or fewer persons.²¹⁶ Many of the licensees in these services are individuals, and thus are not small entities. In addition, due to the mostly unlicensed and shared nature of the spectrum utilized in many of these services, the Commission lacks direct information upon which to base an estimation of the number of small entities under an SBA definition that might be directly affected by our proposed actions.

²¹⁰ *Amendment of Parts 2 and 25 of the Commission’s Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range; Amendment of the Commission’s Rules to Authorize Subsidiary Terrestrial Use of the 12.2-12.7 GHz Band by Direct Broadcast Satellite Licenses and their Affiliates; and Applications of Broadwave USA, PDC Broadband Corporation, and Satellite Receivers, Ltd. to provide A Fixed Service in the 12.2-12.7 GHz Band*, ET Docket No. 98-206, Memorandum Opinion and Order and Second Report and Order, 17 FCC Rcd 9614, 9711, ¶ 252 (2002).

²¹¹ See Letter from Hector V. Barreto, Administrator, U.S. Small Business Administration, to Margaret W. Wiener, Chief, Auctions and Industry Analysis Division, WTB, FCC (Feb.13, 2002).

²¹² See “Multichannel Video Distribution and Data Service Auction Closes,” Public Notice, 19 FCC Rcd 1834 (2004).

²¹³ See “Auction of Multichannel Video Distribution and Data Service Licenses Closes; Winning Bidders Announced for Auction No. 63,” Public Notice, 20 FCC Rcd 19807 (2005).

²¹⁴ 47 CFR part 90.

²¹⁵ The Citizens Band Radio Service, General Mobile Radio Service, Radio Control Radio Service, Family Radio Service, Wireless Medical Telemetry Service, Medical Implant Communications Service, Low Power Radio Service, and Multi-Use Radio Service are governed by subpart D, subpart A, subpart C, subpart B, subpart H, subpart I, subpart G, and subpart J, respectively, of part 95 of the Commission’s rules. See generally 47 CFR part 95.

²¹⁶ 13 CFR § 121.201, NAICS Code 517210.

Public Safety Radio Services. Public Safety radio services include police, fire, local government, forestry conservation, highway maintenance, and emergency medical services.²¹⁷ There are a total of approximately 127,540 licensees in these services. Governmental entities²¹⁸ as well as private businesses comprise the licensees for these services. All governmental entities with populations of less than 50,000 fall within the definition of a small entity.²¹⁹

IMTS Resale Carriers. Providers of IMTS resale services are common carriers that purchase IMTS from other carriers and resell it to their own customers. Under that size standard, such a business is small if it has 1,500 or fewer employees.²²⁰ Census data for 2007 show that 1,523 firms provided resale services during that year. Of that number, 1,522 operated with fewer than 1000 employees and one operated with more than 1,000.²²¹ Thus under this category and the associated small business size standard, the majority of these local resellers can be considered small entities. According to Commission data, 213 carriers have reported that they are engaged in the provision of local resale services.²²² Of these, an estimated 211 have 1,500 or fewer employees and two have more than 1,500 employees.²²³ Consequently, the Commission estimates that the majority of IMTS resellers are small entities that may be affected by our proposed actions.

Wireless Carriers and Service Providers. Included among the providers of IMTS resale are a number of wireless carriers that also provide wireless telephony services domestically. The Commission classifies these entities as providers of Commercial Mobile Radio Services (CMRS). At present, most, if not all, providers of CMRS that offer IMTS provide such service by purchasing IMTS from other carriers to resell it to their customers. The Commission has not developed a size standard specifically for CMRS providers that offer resale IMTS. Such entities would fall within the larger category of wireless carriers and service providers. For those services subject to auctions, the Commission notes that, as a general matter, the number of winning bidders that qualify as small businesses at the close of an auction does not

²¹⁷ With the exception of the special emergency service, these services are governed by subpart B of part 90 of the Commission's Rules, 47 CFR §§ 90.15-90.27. The police service includes approximately 27,000 licensees that serve state, county, and municipal enforcement through telephony (voice), telegraphy (code) and teletype and facsimile (printed material). The fire radio service includes approximately 23,000 licensees comprised of private volunteer or professional fire companies as well as units under governmental control. The local government service is presently comprised of approximately 41,000 licensees that are state, county, or municipal entities that use the radio for official purposes not covered by other public safety services. There are approximately 7,000 licensees within the forestry service which is comprised of licensees from state departments of conservation and private forest organizations who set up communications networks among fire lookout towers and ground crews. The approximately 9,000 state and local governments are licensed for highway maintenance service to provide emergency and routine communications to aid other public safety services to keep main roads safe for vehicular traffic. The approximately 1,000 licensees in the Emergency Medical Radio Service ("EMRS") use the 39 channels allocated to this service for emergency medical service communications related to the delivery of emergency medical treatment. 47 CFR §§ 90.15-90.27. The approximately 20,000 licensees in the special emergency service include medical services, rescue organizations, veterinarians, handicapped persons, disaster relief organizations, school buses, beach patrols, establishments in isolated areas, communications standby facilities, and emergency repair of public communications facilities. 47 CFR §§ 90.33-90.55.

²¹⁸ 47 CFR § 1.1162.

²¹⁹ 5 U.S.C. § 601(5).

²²⁰ 13 CFR § 121.201, NAICS code 517911.

²²¹ http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-skip=800&-ds_name=EC0751SSSZ5&-lang=en.

²²² See *Trends in Telephone Service*, at Tbl. 5.3.

²²³ *Id.*

necessarily represent the number of small businesses currently in service. Also, the Commission does not generally track subsequent business size unless, in the context of assignments or transfers, unjust enrichment issues are implicated.

D. Description of Projected Reporting, Recordkeeping, and Other Compliance Requirements

The proposals being made in this *Notice*, may require additional analysis and mitigation activities regarding compliance with our RF exposure limits for certain facilities, operations, and transmitters, such as some wireless base stations, particularly those on rooftops, and some antennas at multiple transmitter sites. In other cases, current analytical requirements are being relaxed.

E. Steps Taken to Minimize Significant Economic Impact on Small Entities, and Significant Alternatives Considered

The RFA requires an agency to describe any significant, specifically small business, alternatives that it has considered in reaching its proposed approach, which may include the following four alternatives (among others): “(1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance or reporting requirements under the rule for such small entities; (3) the use of performance rather than design standards; and (4) an exemption from coverage of the rule, or any part thereof, for such small entities.”²²⁴ In this proceeding, our proposals are consistent with (2), in that our goal is making our RF rules more consistent and clarifying certain areas that have created confusion in the past. In addition, due to our revisions in our policy on categorical exclusions, we are providing exemptions from RF exposure routine evaluation for many small entities that should reduce the overall impact on small entities (see number 4 above).

F. Federal Rules that May Duplicate, Overlap, or Conflict with the Proposed Rule

None.

²²⁴ 5 U.S.C. § 603(c).

APPENDIX D

Final Regulatory Flexibility Analysis

As required by the Regulatory Flexibility Act of 1980, as amended (RFA),¹ an Initial Regulatory Flexibility Analysis (IRFA) was incorporated in the *Further Notice of Proposed Rule Making* (FNPRM) in ET Docket 03-137.² The Commission sought written public comment on the proposals in the FNPRM, including comment on the IRFA. This Final Regulatory Flexibility Analysis (FRFA) conforms to the RFA.³

A. Need for, and Objectives of, the Report and Order.

The National Environmental Policy Act of 1969 (NEPA) requires agencies of the Federal Government to evaluate the effects of their actions on the quality of the human environment.⁴ To meet its responsibilities under NEPA, the Commission has adopted requirements for evaluating the environmental impact of its actions.⁵ One of several environmental factors addressed by these requirements is human exposure to radiofrequency (RF) energy emitted by FCC-regulated transmitters, facilities, and devices.⁶

The Second Report and Order amends Parts 1, 2 and 95 of our rules relating to the compliance of FCC-regulated transmitters, facilities, and devices with the guidelines for human exposure to radiofrequency (RF) energy adopted by the Commission in 2013. Specifically, we are making certain revisions in the rules that we believe will result in more efficient, practical, and consistent application of compliance procedures in three parts. First, the Second Report and Order addresses the exemptions from the RF exposure routine evaluation requirement, identifying broad criteria that apply to single and multiple RF sources based on power, distance, and frequency, irrespective of service classifications. The Office of Engineering and Technology (OET),⁷ will offer more detailed case-specific guidance as needed through the Knowledge Database (KDB), as well as through technical bulletins and supplements, such as OET Bulletin 65.⁸

¹ See 5 U.S.C. § 603. The RFA, see 5 U.S.C. §§ 601-612, has been amended by the Contract With America Advancement Act of 1996, Public Law 104-121, 110 Stat. 847 (1996) (CWAAA). Title II of the CWAAA is the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA).

² *Proposed Changes in the Commission's Rules Regarding Human Exposure to Radiofrequency Electromagnetic Fields*, ET Docket No. 03-137, *First Report and Order*, *Further Notice of Proposed Rulemaking*, and *Notice of Inquiry*, 28 FCC Rcd 3498, 3533-69, paras. 108-204 (2013) (*2013 RF Order and Notice*).

³ See 5 U.S.C. § 604.

⁴ National Environmental Policy Act of 1969, as amended, 42 U.S.C. §§ 4321-35.

⁵ See 47 CFR pt. 1, subpt. I.

⁶ See, e.g., 47 CFR § 1.1310; *2013 Order and Notice*, 28 FCC Rcd 3498, 3505-32, paras. 14-107 (2013).

⁷ OET has developed a substantial body of guidance that is available via public notices, frequently asked questions (FAQ's), and specific process guidance all of which is compiled in our online Knowledge Database (KDB). See <https://apps.fcc.gov/oetcf/kdb/>. Equipment authorization topics that relate to new services and devices authorized by the Commission are often addressed in the KDB. This includes, for example, simple answers to questions, guidance on how to file for authorization of new types of devices, and guidance on how to conduct compliance testing. The staff guidance provided in the KDB is intended to assist the public in following Commission requirements and is non-binding.

⁸ FCC Office of Engineering and Technology, *Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields*, OET Bulletin 65, Edition 97-01 (1997) (OET Bulletin 65). OET Bulletin 65 provides guidance in determining whether proposed or existing transmitting facilities or operations comply with FCC rules limiting human exposure to RF energy. *Id.* at 1. Supplements A and B to OET Bulletin 65 provide specialized guidance for specific services – broadcasting and amateur radio, respectively – in their compliance determinations.

Second, the Second Report and Order clarifies the calculation or measurement methodologies that should be used, in cases where no exemption applies, to determine potential RF exposure levels in the RF exposure evaluation process. The third and final section of the Second Report and Order addresses post-evaluation mitigation procedures, like access, signage, and training, to ensure that persons – both the general public and trained personnel – are not exposed to RF emissions in excess of our established exposure limits. The new rules clarify the obligations of licensees to provide safety training to workers and to supervise any members of the general public (including untrained workers) who are permitted to enter a restricted area.

B. Summary of Significant Issues Raised by Public Comments in Response to the IRFA

No public comments were filed in response to the IRFA in this proceeding. In addition, no comments were submitted concerning small business issues.

C. Response to Comments by the Chief Counsel for Advocacy of the Small Business Administration

Pursuant to the Small Business Jobs Act of 2010, which amended the RFA, the Commission is required to respond to any comments filed by the Chief Counsel for Advocacy of the Small Business Administration (SBA), and to provide a detailed statement of any change made to the proposed rules as a result of those comments.⁹ The Chief Counsel did not file any comments in response to the proposed rules in this proceeding.

D. Description and Estimate of the Number of Small Entities to Which Rules Will Apply

The RFA directs agencies to provide a description of, and, where feasible, an estimate of, the number of small entities that may be affected by the rules adopted herein.¹⁰ The RFA generally defines the term “small entity” as having the same meaning as the terms “small business,” “small organization,” and “small governmental jurisdiction.”¹¹ In addition, the term “small business” has the same meaning as the term “small business concern” under the Small Business Act.¹² A “small business concern” is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the SBA.¹³

Small Businesses, Small Organizations, and Small Governmental Jurisdictions. Our action may, over time, affect small entities that are not easily categorized at present. We therefore describe here, at the outset, three comprehensive, statutory small entity size standards.¹⁴ First, nationwide, there are a total of

⁹ 5 U.S.C. § 604(a)(3).

¹⁰ 5 U.S.C. § 603(b)(3).

¹¹ 5 U.S.C. § 601(6).

¹² 5 U.S.C. § 601(3) (incorporating by reference the definition of “small-business concern” in the Small Business Act, 15 U.S.C. § 632). Pursuant to 5 U.S.C. § 601(3), the statutory definition of a small business applies “unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register.”

¹³ 15 U.S.C. § 632.

¹⁴ See 5 U.S.C. § 601(3)–(6).

approximately 27.5 million small businesses, according to the SBA.¹⁵ In addition, a “small organization” is generally “any not-for-profit enterprise which is independently owned and operated and is not dominant in its field.”¹⁶ Nationwide, as of 2007, there were approximately 1,621,315 small organizations.¹⁷ Finally, the term “small governmental jurisdiction” is defined generally as “governments of cities, towns, townships, villages, school districts, or special districts, with a population of less than fifty thousand.”¹⁸ Census Bureau data for 2011 indicate that there were 89,476 local governmental jurisdictions in the United States.¹⁹ We estimate that, of this total, as many as 88,506 entities may qualify as “small governmental jurisdictions.”²⁰ Thus, we estimate that most governmental jurisdictions are small.

Experimental Radio Service (Other Than Broadcast). The majority of experimental licenses are issued to companies such as Motorola and Department of Defense contractors such as Northrop, Lockheed and Martin Marietta. Businesses such as these may have as many as 200 licenses at one time. The majority of these applications are from entities such as these. Given this fact, the remaining 30 percent of applications, we assume, for purposes of our evaluations and conclusions in this FRFA, will be awarded to small entities, as that term is defined by the SBA.

The Commission processes approximately 1,000 applications a year for experimental radio operations. About half or 500 of these are renewals and the other half are for new licenses. We do not have adequate information to predict precisely how many of these applications will be impacted by our rule revisions. However, based on the above figures we estimate that as many as 300 of these applications could be from small entities and potentially could be impacted.

International Broadcast Stations. Commission records show that there are 19 international high frequency broadcast station authorizations. We do not request nor collect annual revenue information and are unable to estimate the number of international high frequency broadcast stations that would constitute a small business under the SBA definition. Since all international broadcast stations operate using relatively high power levels, it is likely that they could all be impacted by our rule revisions.

Satellite Telecommunications. Two economic census categories address the satellite industry. The first category has a small business size standard of \$15 million or less in average annual receipts, under SBA

¹⁵ See SBA, Office of Advocacy, “Frequently Asked Questions,” web.sba.gov/faqs (last visited May 6, 2011; figures are from 2009).

¹⁶ 5 U.S.C. § 601(4).

¹⁷ INDEPENDENT SECTOR, THE NEW NONPROFIT ALMANAC & DESK REFERENCE (2010).

¹⁸ 5 U.S.C. § 601(5).

¹⁹ U.S. CENSUS BUREAU, STATISTICAL ABSTRACT OF THE UNITED STATES: 2011, Table 427 (2007)

²⁰The 2007 U.S. Census data for small governmental organizations indicate that there were 89,476 “Local Governments” in 2007. (U.S. CENSUS BUREAU, STATISTICAL ABSTRACT OF THE UNITED STATES 2011, Table 428.) The criterion by which the size of such local governments is determined to be small is a population of 50,000. However, since the Census Bureau does not specifically apply that criterion, it cannot be determined with precision how many of such local governmental organizations is small. Nonetheless, the inference seems reasonable that substantial number of these governmental organizations has a population of less than 50,000. To look at Table 428 in conjunction with a related set of data in Table 429 in the Census’s Statistical Abstract of the U.S., that inference is further supported by the fact that in both Tables, many entities that may well be small are included in the 89,476 local governmental organizations, e.g. county, municipal, township and town, school district and special district entities. Measured by a criterion of a population of 50,000 many specific sub-entities in this category seem more likely than larger county-level governmental organizations to have small populations. Accordingly, of the 89,476 small governmental organizations identified in the 2007 Census, the Commission estimates that a substantial majority is small. 20 13 CFR § 121.201, NAICS code 517110.

rules.²¹ The second has a size standard of \$25 million or less in annual receipts.²²

The category of Satellite Telecommunications “comprises establishments primarily engaged in providing telecommunications services to other establishments in the telecommunications and broadcasting industries by forwarding and receiving communications signals via a system of satellites or reselling satellite telecommunications.”²³ Census Bureau data for 2007 show that 512 Satellite Telecommunications firms that operated for that entire year.²⁴ Of this total, 464 firms had annual receipts of under \$10 million, and 18 firms had receipts of \$10 million to \$24,999,999.²⁵ Consequently, the Commission estimates that the majority of Satellite Telecommunications firms are small entities that might be affected by our actions.

The second category, i.e., “All Other Telecommunications” comprises “establishments primarily engaged in providing specialized telecommunications services, such as satellite tracking, communications telemetry, and radar station operation. This industry also includes establishments primarily engaged in providing satellite terminal stations and associated facilities connected with one or more terrestrial systems and capable of transmitting telecommunications to, and receiving telecommunications from, satellite systems. Establishments providing Internet services or voice over Internet protocol (VoIP) services via client-supplied telecommunications connections are also included in this industry.”²⁶ For this category, Census Bureau data for 2007 shows that there were a total of 2,383 firms that operated for the entire year.²⁷ Of this total, 2,347 firms had annual receipts of under \$25 million and 12 firms had annual receipts of \$25 million to \$49,999,999.²⁸ Consequently, the Commission estimates that the majority of All Other Telecommunications firms are small entities that might be affected by our actions.

Fixed Satellite Transmit/Receive Earth Stations. There are approximately 4,303 earth station authorizations, a portion of which are Fixed Satellite Transmit/Receive Earth Stations. We do not request or collect annual revenue information, and are unable to estimate the number of the earth stations that would constitute small businesses under the SBA definition. However, the majority of these stations could be impacted by our revised rules.

Fixed Satellite Small Transmit/Receive Earth Stations. There are approximately 4,303 earth station authorizations, a portion of which are Fixed Satellite Small Transmit/Receive Earth Stations. We do not request or collect annual revenue information, and are unable to estimate the number of fixed small satellite transmit/receive earth stations that would constitute small businesses under the SBA definition. However, the majority of these stations could be impacted by our revised rules.

Fixed Satellite Very Small Aperture Terminal (VSAT) Systems. These stations operate on a primary basis, and frequency coordination with terrestrial microwave systems is not required. Thus, a single

²¹ 13 CFR § 121.201, NAICS code 517410.

²² 13 CFR § 121.201, NAICS code 517919.

²³ U.S. Census Bureau, 2007 NAICS Definitions, 517410 Satellite Telecommunications.

²⁴ See http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-skip=900&-ds_name=EC0751SSSZ4&-lang=en.

²⁵ See http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-skip=900&-ds_name=EC0751SSSZ4&-lang=en.

²⁶ <http://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517919&search=2007%20NAICS%20Search>.

²⁷ http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-skip=900&-ds_name=EC0751SSSZ4&-lang=en.

²⁸ http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-skip=900&-ds_name=EC0751SSSZ4&-lang=en.

"blanket" application may be filed for a specified number of small antennas and one or more hub stations. There are 492 current VSAT System authorizations. We do not request or collect annual revenue information, and are unable to estimate the number of VSAT systems that would constitute small businesses under the SBA definition. However, it is expected that many of these stations could be impacted by our revised rules.

Mobile Satellite Earth Stations. There are 19 licensees. We do not request or collect annual revenue information, and are unable to estimate the number of mobile satellite earth stations that would constitute small businesses under the SBA definition. However, it is expected that many of these stations could be impacted by our revised rules.

Wireless Telecommunications Carriers (except Satellite). This industry comprises establishments engaged in operating and maintaining switching and transmission facilities to provide communications via the airwaves. Establishments in this industry have spectrum licenses and provide services using that spectrum, such as cellular phone services, paging services, wireless Internet access, and wireless video services.²⁹ The appropriate size standard under SBA rules is for the category Wireless Telecommunications Carriers. The size standard for that category is that a business is small if it has 1,500 or fewer employees.³⁰ Under the present and prior categories, the SBA has deemed a wireless business to be small if it has 1,500 or fewer employees.³¹ For this category, census data for 2007 show that there were 1,383 firms that operated for the entire year.³² Of this total, 1,368 firms had employment of 999 or fewer employees and 15 had employment of 1000 employees or more.³³ Thus under this category and the associated small business size standard, the Commission estimates that the majority of wireless telecommunications carriers(except satellite) are small entities that may be affected by our proposed actions.³⁴

Licenses Assigned by Auctions. Initially, we note that, as a general matter, the number of winning bidders that qualify as small businesses at the close of an auction does not necessarily represent the number of small businesses currently in service. Also, the Commission does not generally track subsequent business size unless, in the context of assignments or transfers, unjust enrichment issues are implicated.

Paging Services. Neither the SBA nor the FCC has developed a definition applicable exclusively to paging services. However, a variety of paging services is now categorized under Wireless Telecommunications Carriers (except satellite).³⁵ This industry comprises establishments engaged in operating and maintaining switching and transmission facilities to provide communications via the airwaves. Establishments in this industry have spectrum licenses and provide services using that

²⁹ <http://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517210&search=2007%20NAICS%20Search>.

³⁰ 13 CFR § 121.201, NAICS code 517210.

³¹ 13 CFR § 121.201, NAICS code 517210. The now-superseded, pre-2007 CFR citations were 13 CFR § 121.201, NAICS codes 517211 and 517212 (referring to the 2002 NAICS).

³² U.S. Census Bureau, Subject Series: Information, Table 5, "Establishment and Firm Size: Employment Size of Firms for the United States: 2007 NAICS Code 517210" (issued Nov. 2010).

³³ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with "1000 employees or more."

³⁴ See http://factfinder.census.gov/servlet/IBQTable?_bm=y&-fds_name=EC0700A1&-geo_id=&-_skip=600&-ds_name=EC0751SSSZ5&-_lang=en.

³⁵ U.S. Census Bureau, 2007 NAICS Definitions, "517210 Wireless Telecommunications Categories (Except Satellite)"; <http://www.census.gov/naics/2007/def/ND517210.HTM#N517210>.

spectrum, such as cellular phone services, paging services, wireless Internet access, and wireless video services. Illustrative examples in the paging context include paging services, except satellite; two-way paging communications carriers, except satellite; and radio paging services communications carriers. The SBA has deemed a paging service in this category to be small if it has 1,500 or fewer employees.³⁶ For this category, census data for 2007 show that there were 1,383 firms that operated for the entire year.³⁷ Of this total, 1,368 firms had employment of 999 or fewer employees and 15 had employment of 1000 employees or more.³⁸ Thus under this category and the associated small business size standard, the Commission estimates that the majority of paging services in the category of wireless telecommunications carriers(except satellite) are small entities that may be affected by our actions.³⁹

In addition, in the Paging Second Report and Order, the Commission adopted a size standard for “small businesses” for purposes of determining their eligibility for special provisions such as bidding credits.⁴⁰ A small business is an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$15 million for the preceding three years.⁴¹ The SBA has approved this definition.⁴² An initial auction of Metropolitan Economic Area (“MEA”) licenses was conducted in the year 2000. Of the 2,499 licenses auctioned, 985 were sold.⁴³ Fifty-seven companies claiming small business status won 440 licenses.⁴⁴ A subsequent auction of MEA and Economic Area (“EA”) licenses was held in the year 2001. Of the 15,514 licenses auctioned, 5,323 were sold.⁴⁵ One hundred thirty-two companies claiming small business status purchased 3,724 licenses. A third auction, consisting of 8,874 licenses in each of 175 EAs and 1,328 licenses in all but three of the 51 MEAs, was held in 2003. Seventy-seven bidders claiming small or very small business status won 2,093 licenses.⁴⁶ A fourth auction of 9,603 lower and upper band paging licenses was held in the year 2010. 29 bidders claiming small or very small business status won 3,016 licenses.

³⁶ U.S. Census Bureau, 2007 NAICS Definitions, “517210 Wireless Telecommunications Categories (Except Satellite)”

³⁷ U.S. Census Bureau, Subject Series: Information, Table 5, “Establishment and Firm Size: Employment Size of Firms for the United States: 2007 NAICS Code 517210” (issued Nov. 2010).

³⁸ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

³⁹ See http://factfinder.census.gov/servlet/IBQTable?_bm=y&-fds_name=EC0700A1&-geo_id=&-skip=600&-ds_name=EC0751SSSZ5&-lang=en.

⁴⁰ *Revision of Part 22 and Part 90 of the Commission’s Rules to Facilitate Future Development of Paging Systems*, Second Report and Order, 12 FCC Rcd 2732, 2811-2812, paras. 178-181 (“*Paging Second Report and Order*”); see also *Revision of Part 22 and Part 90 of the Commission’s Rules to Facilitate Future Development of Paging Systems*, Memorandum Opinion and Order on Reconsideration, 14 FCC Rcd 10030, 10085-10088, ¶¶ 98-107 (1999).

⁴¹ *Paging Second Report and Order*, 12 FCC Rcd at 2811, ¶ 179.

⁴² See Letter from Aida Alvarez, Administrator, SBA, to Amy Zoslov, Chief, Auctions and Industry Analysis Division, Wireless Telecommunications Bureau (“WTB”), FCC (Dec. 2, 1998) (“*Alvarez Letter 1998*”).

⁴³ See “*929 and 931 MHz Paging Auction Closes*,” Public Notice, 15 FCC Rcd 4858 (WTB 2000).

⁴⁴ See *id.*

⁴⁵ See “*Lower and Upper Paging Band Auction Closes*,” Public Notice, 16 FCC Rcd 21821 (WTB 2002).

⁴⁶ See “*Lower and Upper Paging Bands Auction Closes*,” Public Notice, 18 FCC Rcd 11154 (WTB 2003). The current number of small or very small business entities that hold wireless licenses may differ significantly from the number of such entities that won in spectrum auctions due to assignments and transfers of licenses in the secondary market over time. In addition, some of the same small business entities may have won licenses in more than one auction.

2.3 GHz Wireless Communications Services. This service can be used for fixed, mobile, radiolocation, and digital audio broadcasting satellite uses. The Commission defined “small business” for the wireless communications services (“WCS”) auction as an entity with average gross revenues of \$40 million for each of the three preceding years, and a “very small business” as an entity with average gross revenues of \$15 million for each of the three preceding years.⁴⁷ The SBA approved these definitions.⁴⁸ The Commission conducted an auction of geographic area licenses in the WCS service in 1997. In the auction, seven bidders that qualified as very small business entities won 31 licenses, and one bidder that qualified as a small business entity won a license.

1670-1675 MHz Services. This service can be used for fixed and mobile uses, except aeronautical mobile.⁴⁹ An auction for one license in the 1670-1675 MHz band was conducted in 2003. The Commission defined a “small business” as an entity with attributable average annual gross revenues of not more than \$40 million for the preceding three years, which would thus be eligible for a 15 percent discount on its winning bid for the 1670-1675 MHz band license. Further, the Commission defined a “very small business” as an entity with attributable average annual gross revenues of not more than \$15 million for the preceding three years, which would thus be eligible to receive a 25 percent discount on its winning bid for the 1670-1675 MHz band license. The winning bidder was not a small entity.

Wireless Telephony. Wireless telephony includes cellular, personal communications services, and specialized mobile radio telephony carriers. As noted, the SBA has developed a small business size standard for Wireless Telecommunications Carriers (except Satellite).⁵⁰ Under the SBA small business size standard, a business is small if it has 1,500 or fewer employees.⁵¹ Census data for 2007 shows that there were 1,383 firms that operated that year.⁵² Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus, under this category and the associated small business size standard, the majority of firms can be considered small. According to Trends in Telephone Service data, 434 carriers reported that they were engaged in wireless telephony.⁵³ Of these, an estimated 222 have 1,500 or fewer employees and 212 have more than 1,500 employees.⁵⁴ Therefore, approximately half of these entities can be considered small. Similarly, according to Commission data, 413 carriers reported that they were engaged in the provision of wireless telephony, including cellular service, Personal Communications Service (PCS), and Specialized Mobile Radio (SMR) Telephony services.⁵⁵ Of these, an estimated 261 have 1,500 or fewer employees and 152 have more than 1,500 employees.⁵⁶ Consequently, the Commission estimates that approximately half or more of these firms can be considered small. Thus, using available data, we estimate that the majority of wireless firms can be

⁴⁷ *Amendment of the Commission’s Rules to Establish Part 27, the Wireless Communications Service (WCS)*, Report and Order, 12 FCC Rcd 10785, 10879, para. 194 (1997).

⁴⁸ *See Alvarez Letter 1998*.

⁴⁹ 47 CFR § 2.106; *see generally* 47 CFR §§ 27.1–.70.

⁵⁰ 13 CFR § 121.201, NAICS code 517312.

⁵¹ *Id.*

⁵² U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-skip=700&-ds_name=EC0751SSSZ5&-lang=en.

⁵³ *Trends in Telephone Service*, at Tbl. 5.3.

⁵⁴ *Id.*

⁵⁵ *See Trends in Telephone Service*, at Tbl. 5.3.

⁵⁶ *See id.*

considered small.

Broadband Personal Communications Service. The broadband personal communications services (PCS) spectrum is divided into six frequency blocks designated A through F, and the Commission has held auctions for each block. The Commission initially defined a “small business” for C- and F-Block licenses as an entity that has average gross revenues of \$40 million or less in the three previous years.⁵⁷ For F-Block licenses, an additional small business size standard for “very small business” was added and is defined as an entity that, together with its affiliates, has average gross revenues of not more than \$15 million for the preceding three years.⁵⁸ These small business size standards, in the context of broadband PCS auctions, have been approved by the SBA.⁵⁹ No small businesses within the SBA-approved small business size standards bid successfully for licenses in Blocks A and B. There were 90 winning bidders that claimed small business status in the first two C-Block auctions. A total of 93 bidders that claimed small and very small business status won approximately 40 percent of the 1,479 licenses in the first auction for the D, E, and F Blocks.⁶⁰ On April 15, 1999, the Commission completed the re-auction of 347 C-, D-, E-, and F-Block licenses in Auction No. 22.⁶¹ Of the 57 winning bidders in that auction, 48 claimed small business status and won 277 licenses.

On January 26, 2001, the Commission completed the auction of 422 C and F Block Broadband PCS licenses in Auction No. 35. Of the 35 winning bidders in that auction, 29 claimed small business status.⁶² Subsequent events concerning Auction 35, including judicial and agency determinations, resulted in a total of 163 C and F Block licenses being available for grant. On February 15, 2005, the Commission completed an auction of 242 C-, D-, E-, and F-Block licenses in Auction No. 58. Of the 24 winning bidders in that auction, 16 claimed small business status and won 156 licenses.⁶³ On May 21, 2007, the Commission completed an auction of 33 licenses in the A, C, and F Blocks in Auction No. 71.⁶⁴ Of the 14 winning bidders in that auction, six claimed small business status and won 18 licenses.⁶⁵ On August 20, 2008, the Commission completed the auction of 20 C-, D-, E-, and F-Block Broadband PCS licenses in Auction No. 78.⁶⁶ Of the eight winning bidders for Broadband PCS licenses in that auction, six

⁵⁷ See *Amendment of Parts 20 and 24 of the Commission's Rules – Broadband PCS Competitive Bidding and the Commercial Mobile Radio Service Spectrum Cap; Amendment of the Commission's Cellular/PCS Cross-Ownership Rule*, WT Docket No. 96-59, GN Docket No. 90-314, Report and Order, 11 FCC Rcd 7824, 7850–52, paras. 57–60 (1996) (“*PCS Report and Order*”); see also 47 CFR § 24.720(b).

⁵⁸ See *PCS Report and Order*, 11 FCC Rcd at 7852, para. 60.

⁵⁹ See *Alvarez Letter 1998*.

⁶⁰ See *Broadband PCS, D, E and F Block Auction Closes*, Public Notice, Doc. No. 89838 (Jan. 14, 1997).

⁶¹ See *C, D, E, and F Block Broadband PCS Auction Closes*, Public Notice, 14 FCC Rcd 6688 (WTB 1999). Before Auction No. 22, the Commission established a very small standard for the C Block to match the standard used for F Block. *Amendment of the Commission's Rules Regarding Installment Payment Financing for Personal Communications Services (PCS) Licensees*, WT Docket No. 97-82, Fourth Report and Order, 13 FCC Rcd 15743, 15768, para. 46 (1998).

⁶² See *C and F Block Broadband PCS Auction Closes; Winning Bidders Announced*, Public Notice, 16 FCC Rcd 2339 (2001).

⁶³ See *Broadband PCS Spectrum Auction Closes; Winning Bidders Announced for Auction No. 58*, Public Notice, 20 FCC Rcd 3703 (2005).

⁶⁴ See *Auction of Broadband PCS Spectrum Licenses Closes; Winning Bidders Announced for Auction No. 71*, Public Notice, 22 FCC Rcd 9247 (2007).

⁶⁵ *Id.*

⁶⁶ See *Auction of AWS-1 and Broadband PCS Licenses Closes; Winning Bidders Announced for Auction 78*, Public Notice, 23 FCC Rcd 12749 (WTB 2008).

claimed small business status and won 14 licenses.⁶⁷

Advanced Wireless Services. In 2006, the Commission conducted its first auction of Advanced Wireless Services licenses in the 1710-1755 MHz and 2110-2155 MHz bands (“AWS-1”), designated as Auction 66.⁶⁸ For the AWS-1 bands, the Commission has defined a “small business” as an entity with average annual gross revenues for the preceding three years not exceeding \$40 million, and a “very small business” as an entity with average annual gross revenues for the preceding three years not exceeding \$15 million.⁶⁹ In 2006, the Commission conducted its first auction of AWS-1 licenses.⁷⁰ In that initial AWS-1 auction, 31 winning bidders identified themselves as very small businesses won 142 licenses.⁷¹ Twenty-six of the winning bidders identified themselves as small businesses and won 73 licenses.⁷² In a subsequent 2008 auction, the Commission offered 35 AWS-1 licenses.⁷³ Four winning bidders identified themselves as very small businesses, and three of the winning bidders identifying themselves as a small businesses won five AWS-1 licenses.⁷⁴

Narrowband Personal Communications Services. In 1994, the Commission conducted two auctions of Narrowband PCS licenses. For these auctions, the Commission defined a “small business” as an entity with average annual gross revenues for the preceding three years not exceeding \$40 million.⁷⁵ Through these auctions, the Commission awarded a total of 41 licenses, 11 of which were obtained by four small businesses.⁷⁶ To ensure meaningful participation by small business entities in future auctions, the Commission adopted a two-tiered small business size standard in the *Narrowband PCS Second Report*

⁶⁷ *Id.*

⁶⁸ See Auction of Advanced Wireless Services Licenses Scheduled for June 29, 2006; Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments and Other Procedures for Auction No. 66, AU Docket No. 06-30, *Public Notice*, 21 FCC Rcd 4562 (2006) (*Auction 66 Procedures Public Notice*);

⁶⁹ See Service Rules for Advanced Wireless Services in the 1.7 GHz and 2.1 GHz Bands, *Report and Order*, 18 FCC Rcd 25,162, App. B (2003), *modified by* Service Rules for Advanced Wireless Services In the 1.7 GHz and 2.1 GHz Bands, *Order on Reconsideration*, 20 FCC Rcd 14,058, App. C (2005).

⁷⁰ See Auction of Advanced Wireless Services Licenses Scheduled for June 29, 2006; Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments and Other Procedures for Auction No. 66, AU Docket No. 06-30, *Public Notice*, 21 FCC Rcd 4562 (2006) (*Auction 66 Procedures Public Notice*).

⁷¹ See Auction of Advanced Wireless Services Licenses Closes; Winning Bidders Announced for Auction No. 66, *Public Notice*, 21 FCC Rcd 10,521 (2006) (“*Auction 66 Closing Public Notice*”).

⁷² See *id.*

⁷³ See AWS-1 and Broadband PCS Procedures *Public Notice*, 23 FCC Rcd at 7499. Auction 78 also included an auction of broadband PCS licenses.

⁷⁴ See Auction of AWS-1 and Broadband PCS Licenses Closes, Winning Bidders Announced for Auction 78, Down Payments Due September 9, 2008, FCC Forms 601 and 602 Due September 9, 2008, Final Payments Due September 23, 2008, Ten-Day Petition to Deny Period, *Public Notice*, 23 FCC Rcd 12,749 (2008).

⁷⁵ *Implementation of Section 309(j) of the Communications Act – Competitive Bidding Narrowband PCS*, Third Memorandum Opinion and Order and Further Notice of Proposed Rulemaking, 10 FCC Rcd 175, 196, para. 46 (1994).

⁷⁶ See Announcing the High Bidders in the Auction of Ten Nationwide Narrowband PCS Licenses, Winning Bids Total \$617,006,674,” *Public Notice*, PNWL 94-004 (Aug. 2, 1994); “Announcing the High Bidders in the Auction of 30 Regional Narrowband PCS Licenses; Winning Bids Total \$490,901,787,” *Public Notice*, PNWL 94-27 (Nov. 9, 1994).

and Order.⁷⁷ A “small business” is an entity that, together with affiliates and controlling interests, has average gross revenues for the three preceding years of not more than \$40 million.⁷⁸ A “very small business” is an entity that, together with affiliates and controlling interests, has average gross revenues for the three preceding years of not more than \$15 million.⁷⁹ The SBA has approved these small business size standards.⁸⁰ A third auction of Narrowband PCS licenses was conducted in 2001. In that auction, five bidders won 317 (Metropolitan Trading Areas and nationwide) licenses.⁸¹ Three of the winning bidders claimed status as a small or very small entity and won 311 licenses.

Lower 700 MHz Band Licenses. The Commission previously adopted criteria for defining three groups of small businesses for purposes of determining their eligibility for special provisions such as bidding credits.⁸² The Commission defined a “small business” as an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$40 million for the preceding three years.⁸³ A “very small business” is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues that are not more than \$15 million for the preceding three years.⁸⁴ Additionally, the Lower 700 MHz Service had a third category of small business status for Metropolitan/Rural Service Area (“MSA/RSA”) licenses —“entrepreneur”— which is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues that are not more than \$3 million for the preceding three years.⁸⁵ The SBA approved these small size standards.⁸⁶ An auction of 740 licenses was conducted in 2002 (one license in each of the 734 MSAs/RSAs and one license in each of the six Economic Area Groupings (EAGs)). Of the 740 licenses available for auction, 484 licenses were won by 102 winning bidders. Seventy-two of the winning bidders claimed small business, very small business, or entrepreneur status and won a total of 329 licenses.⁸⁷ A second auction commenced on May 28, 2003, closed on June 13, 2003, and included 256 licenses.⁸⁸ Seventeen winning bidders claimed small or very small business status and won 60 licenses, and nine winning bidders claimed entrepreneur status and won 154 licenses.⁸⁹ In 2005, the Commission completed an auction of 5 licenses in the lower 700 MHz band (Auction 60). All three winning bidders claimed small business status.

In 2007, the Commission reexamined its rules governing the 700 MHz band in the *700 MHz Second*

⁷⁷ *Amendment of the Commission’s Rules to Establish New Personal Communications Services, Narrowband PCS, Second Report and Order and Second Further Notice of Proposed Rule Making*, 15 FCC Rcd 10456, 10476, para. 40 (2000) (*Narrowband PCS Second Report and Order*).

⁷⁸ *Narrowband PCS Second Report and Order*, 15 FCC Rcd at 10476, para. 40.

⁷⁹ *Id.*

⁸⁰ *See Alvarez Letter 1998*.

⁸¹ *See* Narrowband PCS Auction Closes, *Public Notice*, 16 FCC Rcd 18663 (WTB 2001).

⁸² *See Reallocation and Service Rules for the 698-746 MHz Spectrum Band (Television Channels 52-59)*, Report and Order, 17 FCC Rcd 1022 (2002) (“*Channels 52-59 Report and Order*”).

⁸³ *See Channels 52-59 Report and Order*, 17 FCC Rcd at 1087-88, para. 172.

⁸⁴ *See id.*

⁸⁵ *See id.* at 1088, para. 173.

⁸⁶ *See* Letter from Aida Alvarez, Administrator, SBA, to Thomas Sugrue, Chief, WTB, FCC (Aug. 10, 1999) (“*Alvarez Letter 1999*”).

⁸⁷ *See* Lower 700 MHz Band Auction Closes, *Public Notice*, 17 FCC Rcd 17272 (WTB 2002).

⁸⁸ *See* Lower 700 MHz Band Auction Closes, *Public Notice*, 18 FCC Rcd 11873 (WTB 2003).

⁸⁹ *See id.*

Report and Order.⁹⁰ An auction of A, B and E block licenses in the Lower 700 MHz band was held in 2008.⁹¹ Twenty winning bidders claimed small business status (those with attributable average annual gross revenues that exceed \$15 million and do not exceed \$40 million for the preceding three years). Thirty-three winning bidders claimed very small business status (those with attributable average annual gross revenues that do not exceed \$15 million for the preceding three years). In 2011, the Commission conducted Auction 92, which offered 16 lower 700 MHz band licenses that had been made available in Auction 73 but either remained unsold or were licenses on which a winning bidder defaulted. Two of the seven winning bidders in Auction 92 claimed very small business status, winning a total of four licenses.

Upper 700 MHz Band Licenses. In the *700 MHz Second Report and Order*, the Commission revised its rules regarding Upper 700 MHz licenses.⁹² On January 24, 2008, the Commission commenced Auction 73 in which several licenses in the Upper 700 MHz band were available for licensing: 12 Regional Economic Area Grouping licenses in the C Block, and one nationwide license in the D Block.⁹³ The auction concluded on March 18, 2008, with 3 winning bidders claiming very small business status (those with attributable average annual gross revenues that do not exceed \$15 million for the preceding three years) and winning five licenses.

700 MHz Guard Band Licenses. In 2000, the Commission adopted the *700 MHz Guard Band Report and Order*, in which it established rules for the A and B block licenses in the Upper 700 MHz band, including size standards for “small businesses” and “very small businesses” for purposes of determining their eligibility for special provisions such as bidding credits.⁹⁴ A small business in this service is an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$40 million for the preceding three years.⁹⁵ Additionally, a very small business is an entity that, together with its affiliates and controlling principals, has average gross revenues that are not more than \$15 million for the preceding three years.⁹⁶ SBA approval of these definitions is not required.⁹⁷ An auction of these licenses was conducted in 2000.⁹⁸ Of the 104 licenses auctioned, 96 licenses were won by nine bidders.

⁹⁰ Service Rules for the 698-746, 747-762 and 777-792 MHz Band, WT Docket No. 06-150, *Revision of the Commission’s Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems*, CC Docket No. 94-102, Section 68.4(a) of the Commission’s Rules Governing Hearing Aid-Compatible Telephone, WT Docket No. 01-309, *Biennial Regulatory Review – Amendment of Parts 1, 22, 24, 27, and 90 to Streamline and Harmonize Various Rules Affecting Wireless Radio Services*, WT Docket No. 03-264, *Former Nextel Communications, Inc. Upper 700 MHz Guard Band Licenses and Revisions to Part 27 of the Commission’s Rules*, WT Docket No. 06-169, *Implementing a Nationwide, Broadband Interoperable Public Safety Network in the 700 MHz Band*, PS Docket No. 06-229, *Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State, and Local Public Safety Communications Requirements Through the Year 2010*, WT Docket No. 96-86, *Second Report and Order*, 22 FCC Rcd 15289 (2007) (*700 MHz Second Report and Order*).

⁹¹ See *Auction of 700 MHz Band Licenses Closes*, *Public Notice*, 23 FCC Rcd 4572 (WTB 2008).

⁹² *700 MHz Second Report and Order*, 22 FCC Rcd 15289.

⁹³ See *Auction of 700 MHz Band Licenses Closes*, *Public Notice*, 23 FCC Rcd 4572 (WTB 2008).

⁹⁴ See *Service Rules for the 746-764 MHz Bands, and Revisions to Part 27 of the Commission’s Rules*, *Second Report and Order*, 15 FCC Rcd 5299 (2000) (*700 MHz Guard Band Report and Order*).

⁹⁵ See *700 MHz Guard Band Report and Order*, 15 FCC Rcd at 5343, para. 108.

⁹⁶ See *id.*

⁹⁷ See *id.* at 5343, para. 108 n.246 (for the 746-764 MHz and 776-794 MHz bands, the Commission is exempt from 15 U.S.C. § 632, which requires Federal agencies to obtain SBA approval before adopting small business size standards).

⁹⁸ See *700 MHz Guard Bands Auction Closes: Winning Bidders Announced*, *Public Notice*, 15 FCC Rcd 18026 (2000).

Five of these bidders were small businesses that won a total of 26 licenses. A second auction of 700 MHz Guard Band licenses was held in 2001. All eight of the licenses auctioned were sold to three bidders. One of these bidders was a small business that won a total of two licenses.⁹⁹

Specialized Mobile Radio. The Commission adopted small business size standards for the purpose of determining eligibility for bidding credits in auctions of Specialized Mobile Radio (SMR) geographic area licenses in the 800 MHz and 900 MHz bands. The Commission defined a “small business” as an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$15 million for the preceding three years.¹⁰⁰ The Commission defined a “very small business” as an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$3 million for the preceding three years.¹⁰¹ The SBA has approved these small business size standards for both the 800 MHz and 900 MHz SMR Service.¹⁰² The first 900 MHz SMR auction was completed in 1996. Sixty bidders claiming that they qualified as small businesses under the \$15 million size standard won 263 licenses in the 900 MHz SMR band. In 2004, the Commission held a second auction of 900 MHz SMR licenses and three winning bidders identifying themselves as very small businesses won 7 licenses.¹⁰³ The auction of 800 MHz SMR licenses for the upper 200 channels was conducted in 1997. Ten bidders claiming that they qualified as small or very small businesses under the \$15 million size standard won 38 licenses for the upper 200 channels.¹⁰⁴ A second auction of 800 MHz SMR licenses was conducted in 2002 and included 23 BEA licenses. One bidder claiming small business status won five licenses.¹⁰⁵

The auction of the 1,053 800 MHz SMR geographic area licenses for the General Category channels was conducted in 2000. Eleven bidders who won 108 licenses for the General Category channels in the 800 MHz SMR band qualified as small or very small businesses.¹⁰⁶ In an auction completed in 2000, a total of 2,800 Economic Area licenses in the lower 80 channels of the 800 MHz SMR service were awarded.¹⁰⁷ Of the 22 winning bidders, 19 claimed small or very small business status and won 129 licenses. Thus, combining all four auctions, 41 winning bidders for geographic licenses in the 800 MHz SMR band claimed to be small businesses.

In addition, there are numerous incumbent site-by-site SMR licensees and licensees with extended implementation authorizations in the 800 and 900 MHz bands. We do not know how many firms provide 800 MHz or 900 MHz geographic area SMR service pursuant to extended implementation authorizations, nor how many of these providers have annual revenues not exceeding \$15 million. One firm has over \$15 million in revenues. In addition, we do not know how many of these firms have 1,500 or fewer

⁹⁹ See 700 MHz Guard Bands Auction Closes: Winning Bidders Announced, *Public Notice*, 16 FCC Rcd 4590 (WTB 2001).

¹⁰⁰ 47 CFR §§ 90.810, 90.814(b), 90.912(b).

¹⁰¹ 47 CFR §§ 90.810, 90.814(b), 90.912(b).

¹⁰² See *Alvarez Letter 1999*.

¹⁰³ See 900 MHz Specialized Mobile Radio Service Spectrum Auction Closes: Winning Bidders Announced, *Public Notice*, 19 FCC Rcd 3921 (WTB 2004).

¹⁰⁴ See Correction to Public Notice DA 96-586 FCC Announces Winning Bidders in the Auction of 1020 Licenses to Provide 900 MHz SMR in Major Trading Areas, *Public Notice*, 18 FCC Rcd 18367 (WTB 1996).

¹⁰⁵ See Multi-Radio Service Auction Closes, *Public Notice*, 17 FCC Rcd 1446 (WTB 2002).

¹⁰⁶ See 800 MHz Specialized Mobile Radio (SMR) Service General Category (851-854 MHz) and Upper Band (861-865 MHz) Auction Closes; Winning Bidders Announced, *Public Notice*, 15 FCC Rcd 17162 (2000).

¹⁰⁷ See 800 MHz SMR Service Lower 80 Channels Auction Closes; Winning Bidders Announced, *Public Notice*, 16 FCC Rcd 1736 (2000).

employees, which is the SBA-determined size standard.¹⁰⁸ We assume, for purposes of this analysis, that all of the remaining extended implementation authorizations are held by small entities, as that small business size standard is approved by the SBA.

220 MHz Radio Service – Phase I Licensees. The 220 MHz service has both Phase I and Phase II licenses. Phase I licensing was conducted by lotteries in 1992 and 1993. There are approximately 1,515 such non-nationwide licensees and four nationwide licensees currently authorized to operate in the 220 MHz band. The Commission has not developed a small business size standard for small entities specifically applicable to such incumbent 220 MHz Phase I licensees. To estimate the number of such licensees that are small businesses, the Commission applies the small business size standard under the SBA rules applicable to Wireless Telecommunications Carriers (except Satellite). Under this category, the SBA deems a wireless business to be small if it has 1,500 or fewer employees.¹⁰⁹ Thus, under this category and the associated small business size standard, the majority of firms can be considered small.

220 MHz Radio Service – Phase II Licensees. The 220 MHz service has both Phase I and Phase II licenses. The Phase II 220 MHz service licenses are assigned by auction, where mutually exclusive applications are accepted. In the *220 MHz Third Report and Order*, the Commission adopted a small business size standard for defining “small” and “very small” businesses for purposes of determining their eligibility for special provisions such as bidding credits.¹¹⁰ This small business standard indicates that a “small business” is an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$15 million for the preceding three years.¹¹¹ A “very small business” is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues that do not exceed \$3 million for the preceding three years.¹¹² The SBA has approved these small business size standards.¹¹³ Auctions of Phase II licenses commenced and closed in 1998.¹¹⁴ In the first auction, 908 licenses were auctioned in three different-sized geographic areas: three nationwide licenses, 30 Regional Economic Area Group (EAG) Licenses, and 875 Economic Area (EA) Licenses. Of the 908 licenses auctioned, 693 were sold.¹¹⁵ Thirty-nine small businesses won 373 licenses in the first 220 MHz auction. A second auction included 225 licenses: 216 EA licenses and 9 EAG licenses. Fourteen companies claiming small business status won 158 licenses.¹¹⁶ A third auction included four licenses: 2 BEA licenses and 2 EAG licenses in the 220 MHz Service. No small or very small business won any of these licenses.¹¹⁷ In 2007, the Commission conducted a fourth auction of the 220 MHz licenses, designated as

¹⁰⁸ See generally 13 CFR § 121.201, NAICS code 517312.

¹⁰⁹ 13 CFR § 121.201, NAICS code 517312.

¹¹⁰ *Amendment of Part 90 of the Commission’s Rules to Provide For the Use of the 220-222 MHz Band by the Private Land Mobile Radio Service*, Third Report and Order and Fifth Notice of Proposed Rulemaking, 12 FCC Rcd 10943, 11068-70, paras. 291-95 (1997).

¹¹¹ *Id.* at 11068, para. 291.

¹¹² *Id.*

¹¹³ See Letter to Daniel Phythyon, Chief, Wireless Telecommunications Bureau, Federal Communications Commission, from Aida Alvarez, Administrator, Small Business Administration, dated January 6, 1998 (*Alvarez to Phythyon Letter 1998*).

¹¹⁴ See generally *220 MHz Service Auction Closes*, Public Notice, 14 FCC Rcd 605 (WTB 1998).

¹¹⁵ See *FCC Announces It is Prepared to Grant 654 Phase II 220 MHz Licenses After Final Payment is Made*, Public Notice, 14 FCC Rcd 1085 (WTB 1999).

¹¹⁶ See *Phase II 220 MHz Service Spectrum Auction Closes*, Public Notice, 14 FCC Rcd 11218 (WTB 1999).

¹¹⁷ See *Multi-Radio Service Auction Closes*, Public Notice, 17 FCC Rcd 1446 (WTB 2002).

Auction 72.¹¹⁸ Auction 72, which offered 94 Phase II 220 MHz Service licenses, concluded in 2007.¹¹⁹ In this auction, five winning bidders won a total of 76 licenses. Two winning bidders identified themselves as very small businesses won 56 of the 76 licenses. One of the winning bidders that identified themselves as a small business won 5 of the 76 licenses won.

Private Land Mobile Radio (PLMR). Private land mobile radio systems serve an essential role in a vast range of industrial, business, land transportation, and public safety activities. Companies of all sizes operating in all U.S. business categories use these radios. Because of the vast array of PLMR users, the Commission has not developed a small business size standard specifically applicable to PLMR users. The closest applicable SBA category is Wireless Telecommunications Carriers (except Satellite) which encompasses business entities engaged in *radiotelephone communications*.¹²⁰ The appropriate size standard for this category under SBA rules is that such a business is small if it has 1,500 or fewer employees.¹²¹ For this industry, U.S. Census Bureau data for 2012 show that there were 967 firms that operated for the entire year.¹²² Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.¹²³ Thus, under this category and the associated size standard, the Commission estimates that the majority of PLMR Licensees are small entities.

According to the Commission's records, a total of approximately 400,622 licenses comprise PLMR users.¹²⁴ Of this number there are a total of approximately 3,174 PLMR licenses in the 4.9 GHz band;¹²⁵ 29,187 PLMR licenses in the 800 MHz band;¹²⁶ and 3,374 licenses in the frequencies range 173.225 MHz to 173.375 MHz.¹²⁷ The Commission does not require PLMR licensees to disclose information about

¹¹⁸ See Auction of Phase II 220 MHz Service Spectrum Scheduled for June 20, 2007, Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments and Other Procedures for Auction 72, *Public Notice*, 22 FCC Rcd 3404 (2007).

¹¹⁹ See *Auction of Phase II 220 MHz Service Spectrum Licenses Closes, Winning Bidders Announced for Auction 72, Down Payments due July 18, 2007, FCC Forms 601 and 602 due July 18, 2007, Final Payments due August 1, 2007, Ten-Day Petition to Deny Period*, *Public Notice*, 22 FCC Rcd 11573 (2007).

¹²⁰ U.S. Census Bureau, 2012 NAICS Definitions, "517210 Wireless Telecommunications Carriers (Except Satellite)," *see* <https://factfinder.census.gov/faces/affhelp/jsf/pages/metadata.xhtml?lang=en&type=ib&id=ib.en/ECN/NAICS2012.517210>.

¹²¹ See 13 CFR § 121.201, NAICS code 517312.

¹²² U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210. https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~517210.

¹²³ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with "1000 employees or more."

¹²⁴ This figure was derived from Commission licensing records as of September 19, 2016. Licensing numbers change on a daily basis. This does not indicate the number of licensees, as licensees may hold multiple licenses. There is no information currently available about the number of PLMR licensees that have fewer than 1,500 employees.

¹²⁵ Based on an FCC Universal Licensing System search of January 26, 2018. Search parameters: Radio Service = PA – Public Safety 4940-4990 MHz Band; Authorization Type = Regular; Status = Active.

¹²⁶ Based on an FCC Universal Licensing System search of May 15, 2017. Search parameters: Radio Service = GB, GE, GF, GJ, GM, GO, GP, YB, YE, YF, YJ, YM, YO, YP, YX; Authorization Type = Regular; Status = Active.

¹²⁷ This figure was derived from Commission licensing records as of August 16, 2013. Licensing numbers change daily. We do not expect this number to be significantly smaller today. This does not indicate the number of licensees, as licensees may hold multiple licenses. There is no information currently available about the number of licensees that have fewer than 1,500 employees.

number of employees, and does not have information that could be used to determine how many PLMR licensees constitute small entities under this definition. The Commission, however, believes that a substantial number of PLMR licensees may be small entities despite the lack of specific information.

Fixed Microwave Services. Microwave services include common carrier,¹²⁸ private-operational fixed,¹²⁹ and broadcast auxiliary radio services.¹³⁰ They also include the Upper Microwave Flexible Use Service,¹³¹ Millimeter Wave Service,¹³² Local Multipoint Distribution Service (LMDS),¹³³ the Digital Electronic Message Service (DEMS),¹³⁴ and the 24 GHz Service,¹³⁵ where licensees can choose between common carrier and non-common carrier status.¹³⁶ At present, there are approximately 66,680 common carrier fixed licensees, 69,360 private and public safety operational-fixed licensees, 20,150 broadcast auxiliary radio licensees, 411 LMDS licenses, 33 24 GHz DEMS licenses, 777 39 GHz licenses, and five 24 GHz licenses, and 467 Millimeter Wave licenses in the microwave services.¹³⁷ The Commission has not yet defined a small business with respect to microwave services. The closest applicable SBA category is Wireless Telecommunications Carriers (except Satellite) and the appropriate size standard for this category under SBA rules is that such a business is small if it has 1,500 or fewer employees.¹³⁸ For this industry, U.S. Census data for 2012 show that there were 967 firms that operated for the entire year.¹³⁹ Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.¹⁴⁰ Thus, under this SBA category and the associated size standard, the Commission estimates that a majority of fixed microwave service licensees can be considered small. The Commission does not have data specifying the number of these licensees that have more than 1,500 employees, and thus is unable at this time to estimate with greater precision the number of fixed microwave service licensees that would qualify as small business concerns under the SBA's small

¹²⁸ See 47 CFR Part 101, Subparts C and I.

¹²⁹ See 47 CFR Part 101, Subparts C and H. Persons eligible under parts 80 and 90 of the Commission's rules can use Private-Operational Fixed Microwave Services. See 47 CFR pts. 80, 90. Stations in this service are called operational-fixed to distinguish them from common carrier and public fixed stations. Only the licensee may use the operational-fixed station and only for communications related to the licensee's commercial, industrial, or safety operations.

¹³⁰ See 47 CFR pts. 74, 78 (governing Auxiliary Microwave Service). Available to licensees of broadcast stations, cable operators, and to broadcast and cable network entities, auxiliary microwave stations are used for relaying broadcast television signals from the studio to the transmitter, or between two points such as a main studio and an auxiliary studio. The service also includes mobile TV pickups and CARS pickup, which relay signals from a remote location back to the studio.

¹³¹ See 47 CFR Part 30.

¹³² See 47 CFR Part 101, Subpart Q.

¹³³ See 47 CFR Part 101, Subpart L.

¹³⁴ See 47 CFR Part 101, Subpart G.

¹³⁵ See *id.*

¹³⁶ See 47 CFR §§ 101.533, 101.1017.

¹³⁷ These statistics are based on a review of the Universal Licensing System on September 22, 2015.

¹³⁸ See 13 CFR § 121.201, NAICS code 517312.

¹³⁹ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, Information: Subject Series, "Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210" (rel. Jan. 8, 2016). https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~517210.

¹⁴⁰ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with "1000 employees or more."

business size standard. Consequently, the Commission estimates that there are up to 36,708 common carrier fixed licensees and up to 59,291 private operational-fixed licensees and broadcast auxiliary radio licensees in the microwave services that may be small and may be affected by the rules and policies adopted herein. We note, however, that the common carrier microwave fixed licensee category does include some large entities.

39 GHz Service. The Commission created a special small business size standard for 39 GHz licenses—an entity that has average gross revenues of \$40 million or less in the three previous calendar years.¹⁴¹ An additional size standard for “very small business” is: an entity that, together with affiliates, has average gross revenues of not more than \$15 million for the preceding three calendar years.¹⁴² The SBA has approved these small business size standards.¹⁴³ The auction of the 2,173 39 GHz licenses began on April 12, 2000, and closed on May 8, 2000. The 18 bidders who claimed small business status won 849 licenses. Consequently, the Commission estimates that 18 or fewer 39 GHz licensees are small entities that may be affected by rules adopted pursuant to the Second Report and Order.

Local Multipoint Distribution Service. Local Multipoint Distribution Service (“LMDS”) is a fixed broadband point-to-multipoint microwave service that provides for two-way video telecommunications.¹⁴⁴ The Commission established a small business size standard for LMDS licenses as an entity that, together with its affiliates and controlling principals, has average gross revenues of less than \$40 million in the three previous years.¹⁴⁵ An additional small business size standard for “very small business” was added as an entity that, together with its affiliates and controlling principals, has average gross revenues of not more than \$15 million for the preceding three years.¹⁴⁶ The SBA has approved these small business size standards in the context of LMDS auctions.¹⁴⁷ There were 93 winning bidders that qualified as small entities in the LMDS auctions. A total of 93 small and very small businesses won approximately 277 A Block licenses and 387 B Block licenses. In 1999, the Commission re-auctioned 161 licenses and there were 32 small and very small businesses that won 119 licenses.

218-219 MHz Service. The first auction of 218-219 MHz spectrum resulted in 170 entities winning licenses for 594 Metropolitan Statistical Area (MSA) licenses. Of the 594 licenses, 557 were won by entities qualifying as a small business. For that auction, the small business size standard was an entity that, together with its affiliates, has no more than a \$6 million net worth and, after federal income taxes (excluding any carry over losses), has no more than \$2 million in annual profits each year for the previous two years.¹⁴⁸ In the *218-219 MHz Report and Order and Memorandum Opinion and Order*, we

¹⁴¹ See *Amendment of the Commission’s Rules Regarding the 37.0-38.6 GHz and 38.6-40.0 GHz Bands*, ET Docket No. 95-183, PP Docket No. 93-253, Report and Order, 12 FCC Rcd 18600, 18661–64, paras. 149–51 (1997).

¹⁴² See *id.*

¹⁴³ See Letter to Kathleen O’Brien Ham, Chief, Auctions and Industry Analysis Division, Wireless Telecommunications Bureau, Federal Communications Commission, from Aida Alvarez, Administrator, SBA (Feb. 4, 1998).

¹⁴⁴ See [Rulemaking to Amend Parts 1, 2, 21, 25, of the Commission’s Rules to Redesignate the 27.5-29.5 GHz Frequency Band, Reallocate the 29.5-30.5 Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services](#), CC Docket No. 92-297, Second Report and Order, Order on Reconsideration, and Fifth Notice of Proposed Rule Making, 12 FCC Rcd 12545, 12689-90, para. 348 (1997) (“*LMDS Second Report and Order*”).

¹⁴⁵ See [LMDS Second Report and Order](#), 12 FCC Rcd at 12689-90, para. 348.

¹⁴⁶ See *id.*

¹⁴⁷ See Letter to D. Phythyon, Chief, Wireless Telecommunications Bureau, Federal Communications Commission, from Aida Alvarez, Administrator, SBA (Jan. 6, 1998) (Alvarez to Phythyon Letter 1998).

¹⁴⁸ See *generally Implementation of Section 309(j) of the Communications Act – Competitive Bidding*, PP Docket No. 93-253, Fourth Report and Order, 9 FCC Rcd 2330 (1994).

established a small business size standard for a “small business” as an entity that, together with its affiliates and persons or entities that hold interests in such an entity and their affiliates, has average annual gross revenues not to exceed \$15 million for the preceding three years.¹⁴⁹ A “very small business” is defined as an entity that, together with its affiliates and persons or entities that hold interests in such an entity and its affiliates, has average annual gross revenues not to exceed \$3 million for the preceding three years.¹⁵⁰ These size standards will be used in future auctions of 218-219 MHz spectrum.

Location and Monitoring Service (LMS). LMS systems use non-voice radio techniques to determine the location and status of mobile radio units. For purposes of auctioning LMS licenses, the Commission has defined a “small business” as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the preceding three years not to exceed \$15 million.¹⁵¹ A “very small business” is defined as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the preceding three years not to exceed \$3 million.¹⁵² These definitions have been approved by the SBA.¹⁵³ An auction for LMS licenses commenced on February 23, 1999, and closed on March 5, 1999. Of the 528 licenses auctioned, 289 licenses were sold to four small businesses.

Rural Radiotelephone Service. The Commission has not adopted a size standard for small businesses specific to the Rural Radiotelephone Service.¹⁵⁴ A significant subset of the Rural Radiotelephone Service is the Basic Exchange Telephone Radio System (BETRS).¹⁵⁵ The closest applicable SBA size standard is for Wireless Telecommunications Carriers (except Satellite), which is an entity employing no more than 1,500 persons.¹⁵⁶ For this industry, U.S. Census Bureau data for 2012 show that there were 967 firms that operated for the entire year.¹⁵⁷ Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.¹⁵⁸ Thus, under this category and the associated size standard, the Commission estimates that the majority of Rural Radiotelephone Services firm are small entities. There are approximately 1,000 licensees in the Rural Radiotelephone Service, and the Commission estimates that there are 1,000 or fewer small entity licensees in the Rural Radiotelephone Service that may be affected by the rules and policies adopted pursuant to the Second Report and Order.

¹⁴⁹ See generally *Amendment of Part 95 of the Commission’s Rules to Provide Regulatory Flexibility in the 218-219 MHz Service*, WT Docket No. 98-169, Report and Order and Memorandum Opinion and Order, 15 FCC Rcd 1497 (1999) (*218-219 MHz Report and Order and Memorandum Opinion and Order*).

¹⁵⁰ See *id.*

¹⁵¹ Amendment of Part 90 of the Commission’s Rules to Adopt Regulations for Automatic Vehicle Monitoring Systems, PR Docket No. 93-61, *Second Report and Order*, 13 FCC Rcd 15182, 15192, para. 20 (1998); see also 47 CFR § 90.1103.

¹⁵² *Id.*

¹⁵³ See Letter from Aida Alvarez, Administrator, Small Business Administration to Thomas J. Sugrue, Chief, Wireless Telecommunications Bureau, FCC (Feb. 22, 1999).

¹⁵⁴ The service is defined in 47 CFR § 22.99.

¹⁵⁵ BETRS is defined in 47 CFR §§ 22.757 and 22.759.

¹⁵⁶ 13 CFR § 121.201, NAICS code 517312.

¹⁵⁷ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210. https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~517210.

¹⁵⁸ *Id.* Available census data does not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

Air-Ground Radiotelephone Service. The Commission has previously used the SBA's small business size standard applicable to Wireless Telecommunications Carriers (except Satellite), which is an entity employing no more than 1,500 persons.¹⁵⁹ For this industry, U.S. Census data for 2012 show that there were 967 firms that operated for the entire year. Of this total, 955 firms had fewer than 1,000 employees and 12 had employment of 1000 employees or more.¹⁶⁰ There are approximately 100 licensees in the Air-Ground Radiotelephone Service, and we estimate that almost all of them qualify as small entities under the SBA definition. For purposes of assigning Air-Ground Radiotelephone Service licenses through competitive bidding, the Commission has defined "small business" as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the preceding three years not exceeding \$40 million.¹⁶¹ A "very small business" is defined as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the preceding three years not exceeding \$15 million.¹⁶² These definitions were approved by the SBA.¹⁶³ In May 2006, the Commission completed an auction of nationwide commercial Air-Ground Radiotelephone Service licenses in the 800 MHz band (Auction No. 65). On June 2, 2006, the auction closed with two winning bidders winning two Air-Ground Radiotelephone Services licenses. Neither of the winning bidders claimed small business status.

Aviation and Marine Radio Services. Small businesses in the aviation and marine radio services use a very high frequency (VHF) marine or aircraft radio and, as appropriate, an emergency position-indicating radio beacon (and/or radar) or an emergency locator transmitter. The Commission has not developed a small business size standard specifically applicable to these small businesses. For purposes of this analysis, the Commission uses the SBA small business size standard for the category Wireless Telecommunications Carriers (except Satellite), which is 1,500 or fewer employees.¹⁶⁴ U.S. Census Bureau data for 2012 show that there were 967 firms that operated for the entire year.¹⁶⁵ Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.¹⁶⁶ Most applicants for recreational licenses are individuals. Approximately 581,000 ship station licensees and 131,000 aircraft station licensees operate domestically and are not subject to the radio carriage requirements of any statute or treaty. For purposes of our evaluations in this analysis, we estimate that there are up to approximately 712,000 licensees that are small businesses (or individuals) under the SBA

¹⁵⁹ 13 CFR § 121.201, NAICS code 517312.

¹⁶⁰ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with "1000 employees or more."

¹⁶¹ *Amendment of Part 22 of the Commission's Rules to Benefit the Consumers of Air-Ground Telecommunications Services, Biennial Regulatory Review—Amendment of Parts 1, 22, and 90 of the Commission's Rules, Amendment of Parts 1 and 22 of the Commission's Rules to Adopt Competitive Bidding Rules for Commercial and General Aviation Air-Ground Radiotelephone Service*, Order on Reconsideration and Report and Order, 20 FCC Rcd 19663, paras. 28-42 (2005).

¹⁶² *Id.*

¹⁶³ See Letter from Hector V. Barreto, Administrator, SBA, to Gary D. Michaels, Deputy Chief, Auctions and Spectrum Access Division, Wireless Telecommunications Bureau, Federal Communications Commission (filed Sept. 19, 2005).

¹⁶⁴ See 13 CFR § 121.201, NAICS code 517312.

¹⁶⁵ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210 (Jan. 8, 2016). https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~517210.

¹⁶⁶ *Id.* Available census data does not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with "1000 employees or more."

standard. In addition, between December 3, 1998 and December 14, 1998, the Commission held an auction of 42 VHF Public Coast licenses in the 157.1875-157.4500 MHz (ship transmit) and 161.775-162.0125 MHz (coast transmit) bands. For purposes of the auction, the Commission defined a “small” business as an entity that, together with controlling interests and affiliates, has average gross revenues for the preceding three years not to exceed \$15 million dollars.¹⁶⁷ In addition, a “very small” business is one that, together with controlling interests and affiliates, has average gross revenues for the preceding three years not to exceed \$3 million dollars.¹⁶⁸ There are approximately 10,672 licensees in the Marine Coast Service, and the Commission estimates that almost all of them qualify as “small” businesses under the above special small business size standards.

Offshore Radiotelephone Service. This service operates on several UHF television broadcast channels that are not used for television broadcasting in the coastal areas of states bordering the Gulf of Mexico.¹⁶⁹ The closest applicable SBA size standard is for Wireless Telecommunications Carriers (except Satellite), which is an entity employing no more than 1,500 persons.¹⁷⁰ U.S. Census Bureau data in this industry for 2012 show that there were 967 firms that operated for the entire year.¹⁷¹ Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.¹⁷² Thus, under this SBA category and the associated small business size standard, the majority of Offshore Radiotelephone Service firms can be considered small. There are presently approximately 55 licensees in this service. However, the Commission is unable to estimate at this time the number of licensees that would qualify as small under the SBA’s small business size standard for the category of Wireless Telecommunications Carriers (except Satellite).

Multiple Address Systems. Entities using Multiple Address Systems (MAS) spectrum, in general, fall into two categories: (1) those using the spectrum for profit-based uses, and (2) those using the spectrum for private internal uses. With respect to the first category, Profit-based Spectrum use, the size standards established by the Commission define “small entity” for MAS licensees as an entity that has average annual gross revenues of less than \$15 million over the three previous calendar years.¹⁷³ A “Very small business” is defined as an entity that, together with its affiliates, has average annual gross revenues of not more than \$3 million over the preceding three calendar years.¹⁷⁴ The SBA has approved these definitions.¹⁷⁵ The majority of MAS operators are licensed in bands where the Commission has implemented a geographic area licensing approach that requires the use of competitive bidding procedures to resolve mutually exclusive applications.

¹⁶⁷ See generally *Amendment of the Commission’s Rules Concerning Maritime Communications*, PR Docket No. 92-257, Third Report and Order and Memorandum Opinion and Order, 13 FCC Rcd 19853, 19884–88, paras. 64–73 (1998).

¹⁶⁸ See *id.*

¹⁶⁹ This service is governed by Subpart I of Part 22 of the Commission’s Rules. See 47 CFR §§ 22.1001-22.1037.

¹⁷⁰ 13 CFR § 121.201, NAICS code 517312.

¹⁷¹ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210 (Jan. 8, 2016), https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~5172100.

¹⁷² *Id.* Available census data does not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

¹⁷³ See *Amendment of the Commission’s Rules Regarding Multiple Address Systems, Report and Order*, 15 FCC Rcd 11956, 12008, para. 123 (2000).

¹⁷⁴ *Id.*

¹⁷⁵ See Letter from Aida Alvarez, Administrator, Small Business Administration, to Thomas Sugrue, Chief, Wireless Telecommunications Bureau, FCC (June 4, 1999).

The Commission's licensing database indicates that, as of April 16, 2010, there were a total of 11,653 site-based MAS station authorizations. Of these, 58 authorizations were associated with common carrier service. In addition, the Commission's licensing database indicates that, as of April 16, 2010, there were a total of 3,330 Economic Area market area MAS authorizations. The Commission's licensing database also indicates that, as of April 16, 2010, of the 11,653 total MAS station authorizations, 10,773 authorizations were for private radio service. In 2001, an auction for 5,104 MAS licenses in 176 EAs was conducted.¹⁷⁶ Seven winning bidders claimed status as small or very small businesses and won 611 licenses. In 2005, the Commission completed an auction (Auction 59) of 4,226 MAS licenses in the Fixed Microwave Services from the 928/959 and 932/941 MHz bands. Twenty-six winning bidders won a total of 2,323 licenses. Of the 26 winning bidders in this auction, five claimed small business status and won 1,891 licenses.

With respect to the second category, Internal Private Spectrum use consists of entities that use, or seek to use, MAS spectrum to accommodate their own internal communications needs, MAS serves an essential role in a range of industrial, safety, business, and land transportation activities. MAS radios are used by companies of all sizes, operating in virtually all U.S. business categories, and by all types of public safety entities. For the majority of private internal users, the definition developed by the SBA would be more appropriate than the Commission's definition. The closest applicable definition of a small entity is the "Wireless Telecommunications Carriers (except Satellite)" definition under the SBA rules.¹⁷⁷ The appropriate size standard under SBA rules is that such a business is small if it has 1,500 or fewer employees.¹⁷⁸ For this category, U.S. Census data for 2012 show that there were 967 firms that operated for the entire year.¹⁷⁹ Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.¹⁸⁰ Thus, under this category and the associated small business size standard, the Commission estimates that the majority of firms that may be affected by our action can be considered small.

1.4 GHz Band Licensees. The Commission conducted an auction of 64 1.4 GHz band licenses in the paired 1392-1395 MHz and 1432-1435 MHz bands, and in the unpaired 1390-1392 MHz band in 2007.¹⁸¹ For these licenses, the Commission defined "small business" as an entity that, together with its affiliates and controlling interests, had average gross revenues not exceeding \$40 million for the preceding three years, and a "very small business" as an entity that, together with its affiliates and controlling interests, has had average annual gross revenues not exceeding \$15 million for the preceding three years.¹⁸² Neither of the two winning bidders claimed small business status.¹⁸³

¹⁷⁶ See *Multiple Address Systems Spectrum Auction Closes*, Public Notice, 16 FCC Rcd 21011 (2001).

¹⁷⁷ 13 CFR § 121.201, NAICS Code 517312.

¹⁷⁸ *Id.*

¹⁷⁹ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210. https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~517210.

¹⁸⁰ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with "1000 employees or more."

¹⁸¹ See *Auction of 1.4 GHz Band Licenses Scheduled for February 7, 2007*, Public Notice, 21 FCC Rcd 12393 (WTB 2006); *Auction of 1.4 GHz Band Licenses Closes; Winning Bidders Announced for Auction No. 69*, Public Notice, 22 FCC Rcd 4714 (2007) (*Auction No. 69 Closing PN*).

¹⁸² *Auction No. 69 Closing PN*, Attachment C.

¹⁸³ See *Auction No. 69 Closing PN*.

Incumbent 24 GHz Licensees. This analysis may affect incumbent licensees who were relocated to the 24 GHz band from the 18 GHz band and applicants who wish to provide services in the 24 GHz band. For this service, the Commission uses the SBA small business size standard for the category “Wireless Telecommunications Carriers (Except Satellite),” which is 1,500 or fewer employees.¹⁸⁴ To gauge small business prevalence for these cable services we must, however, use the most current census data. For this industry, U.S. Census Bureau data for 2012 show that there were 967 firms that operated for the entire year.¹⁸⁵ Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.¹⁸⁶ Thus, under this category and the associated small business size standard, the majority of firms can be considered small. The Commission notes that the U.S. Census Bureau’s use of the classification “firms” does not track the number of “licenses.” The Commission believes that there are only two licensees in the 24 GHz band that were relocated from the 18 GHz band, Teligent¹⁸⁷ and TRW, Inc. It is our understanding that Teligent and its related companies have less than 1,500 employees, though this may change in the future. TRW is not a small entity. Thus, only one incumbent licensee in the 24 GHz band is a small business entity.

Future 24 GHz Licensees. With respect to new applicants for licenses in the 24 GHz band, for the purpose of determining eligibility for bidding credits, the Commission established three small business definitions. An “entrepreneur” is defined as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the three preceding years not exceeding \$40 million.¹⁸⁸ A “small business” is defined as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the three preceding years not exceeding \$15 million.¹⁸⁹ A “very small business” in the 24 GHz band is defined as an entity that, together with controlling interests and affiliates, has average gross revenues not exceeding \$3 million for the preceding three years.¹⁹⁰ The SBA has approved these small business size standards.¹⁹¹ In a 2004 auction of 24 GHz licenses, three winning bidders won seven licenses.¹⁹² Two of the winning bidders were very small businesses that won five licenses.

Broadband Radio Service and Educational Broadband Service. Broadband Radio Service systems, previously referred to as Multipoint Distribution Service (MDS) and Multichannel Multipoint Distribution Service (MMDS) systems, and “wireless cable,” transmit video programming to subscribers and provide two-way high speed data operations using the microwave frequencies of the Broadband

¹⁸⁴ 13 CFR § 121.201, NAICS code 517312.

¹⁸⁵ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210. https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~517210.

¹⁸⁶ *Id.* Available census data does not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

¹⁸⁷ Teligent acquired the DEMS licenses of FirstMark, the only licensee other than TRW in the 24 GHz band whose license has been modified to require relocation to the 24 GHz band.

¹⁸⁸ *Amendments to Parts 1, 2, 87 and 101 of the Commission’s Rules to License Fixed Services at 24 GHz*, Report and Order, 15 FCC Rcd 16934, 16967 ¶ 77 (2000) (“24 GHz Report and Order”); *see also* 47 CFR § 101.538(a)(3).

¹⁸⁹ *24 GHz Report and Order*, 15 FCC Rcd at 16967 ¶ 77; *see also* 47 CFR § 101.538(a)(2).

¹⁹⁰ *24 GHz Report and Order*, 15 FCC Rcd at 16967 ¶ 77; *see also* 47 CFR § 101.538(a)(1).

¹⁹¹ *See* Letter to Margaret W. Wiener, Deputy Chief, Auctions and Industry Analysis Division, Wireless Telecommunications Bureau, FCC, from Gary M. Jackson, Assistant Administrator, SBA (July 28, 2000).

¹⁹² *Auction of 24 GHz Service Spectrum Auction Closes, Winning Bidders Announced for Auction 56, Down Payments Due August 16, 2004, Final Payments Due August 30, 2004, Ten-Day Petition to Deny Period*, Public Notice, 19 FCC Rcd 14738 (2004).

Radio Service (BRS) and Educational Broadband Service (EBS) (previously referred to as the Instructional Television Fixed Service (ITFS)).¹⁹³

BRS - In connection with the 1996 BRS auction, the Commission established a small business size standard as an entity that had annual average gross revenues of no more than \$40 million in the previous three calendar years.¹⁹⁴ The BRS auctions resulted in 67 successful bidders obtaining licensing opportunities for 493 Basic Trading Areas (BTAs). Of the 67 auction winners, 61 met the definition of a small business. BRS also includes licensees of stations authorized prior to the auction. At this time, we estimate that of the 61 small business BRS auction winners, 48 remain small business licensees. In addition to the 48 small businesses that hold BTA authorizations, there are approximately 86 incumbent BRS licensees that are considered small entities (18 incumbent BRS licensees do not meet the small business size standard).¹⁹⁵ After adding the number of small business auction licensees to the number of incumbent licensees not already counted, there are currently approximately 133 BRS licensees that are defined as small businesses under either the SBA or the Commission's rules.

In 2009, the Commission conducted Auction 86, the sale of 78 licenses in the BRS areas.¹⁹⁶ The Commission offered three levels of bidding credits: (i) a bidder with attributed average annual gross revenues that exceed \$15 million and do not exceed \$40 million for the preceding three years (small business) received a 15 percent discount on its winning bid; (ii) a bidder with attributed average annual gross revenues that exceed \$3 million and do not exceed \$15 million for the preceding three years (very small business) received a 25 percent discount on its winning bid; and (iii) a bidder with attributed average annual gross revenues that do not exceed \$3 million for the preceding three years (entrepreneur) received a 35 percent discount on its winning bid.¹⁹⁷ Auction 86 concluded in 2009 with the sale of 61 licenses.¹⁹⁸ Of the ten winning bidders, two bidders that claimed small business status won 4 licenses; one bidder that claimed very small business status won three licenses; and two bidders that claimed entrepreneur status won six licenses.

EBS - Educational Broadband Service has been included within the broad economic census category and SBA size standard for Wired Telecommunications Carriers since 2007. Wired Telecommunications Carriers are comprised of establishments primarily engaged in operating and/or providing access to transmission facilities and infrastructure that they own and/or lease for the transmission of voice, data, text, sound, and video using wired telecommunications networks. Transmission facilities may be based on a single technology or a combination of technologies.¹⁹⁹ The SBA's small business size standard for

¹⁹³ *Amendment of Parts 21 and 74 of the Commission's Rules with Regard to Filing Procedures in the Multipoint Distribution Service and in the Instructional Television Fixed Service and Implementation of Section 309(j) of the Communications Act—Competitive Bidding*, Report and Order, 10 FCC Rcd 9589, 9593, para. 7 (1995).

¹⁹⁴ 47 CFR § 21.961(b)(1).

¹⁹⁵ 47 U.S.C. § 309(j). Hundreds of stations were licensed to incumbent MDS licensees prior to implementation of Section 309(j) of the Communications Act of 1934, 47 U.S.C. § 309(j). For these pre-auction licenses, the applicable standard is SBA's small business size standard of 1500 or fewer employees.

¹⁹⁶ *Auction of Broadband Radio Service (BRS) Licenses, Scheduled for October 27, 2009, Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments, and Other Procedures for Auction 86*, Public Notice, 24 FCC Rcd 8277 (2009).

¹⁹⁷ *Id.* at 8296, para. 73.

¹⁹⁸ *Auction of Broadband Radio Service Licenses Closes, Winning Bidders Announced for Auction 86, Down Payments Due November 23, 2009, Final Payments Due December 8, 2009, Ten-Day Petition to Deny Period*, Public Notice, 24 FCC Rcd 13572 (2009).

¹⁹⁹ U.S. Census Bureau, 2017 NAICS Definitions, "517311 Wired Telecommunications Carriers," (partial definition), <http://www.census.gov/cgi-bin/sssd/naics/naicsrhc?code=517311&search=2017>.

this category is all such firms having 1,500 or fewer employees.²⁰⁰ U.S. Census Bureau data for 2012 show that there were 3,117 firms that operated that year.²⁰¹ Of this total, 3,083 operated with fewer than 1,000 employees.²⁰² Thus, under this size standard, the majority of firms in this industry can be considered small. In addition to Census data, the Commission's Universal Licensing System indicates that as of October 2014, there are 2,206 active EBS licenses. The Commission estimates that of these 2,206 licenses, the majority are held by non-profit educational institutions and school districts, which are by statute defined as small businesses.²⁰³

Television Broadcasting. This Economic Census category "comprises establishments primarily engaged in broadcasting images together with sound."²⁰⁴ These establishments operate television broadcast studios and facilities for the programming and transmission of programs to the public.²⁰⁵ These establishments also produce or transmit visual programming to affiliated broadcast television stations, which in turn broadcast the programs to the public on a predetermined schedule. Programming may originate in their own studio, from an affiliated network, or from external sources. The SBA has created the following small business size standard for such businesses: those having \$38.5 million or less in annual receipts.²⁰⁶ The 2012 Economic Census reports that 751 firms in this category operated in that year.²⁰⁷ Of that number, 656 had annual receipts of \$25,000,000 or less, 25 had annual receipts between \$25,000,000 and \$49,999,999 and 70 had annual receipts of \$50,000,000 or more.²⁰⁸ Based on this data we therefore estimate that the majority of commercial television broadcasters are small entities under the applicable SBA size standard.

The Commission has estimated the number of licensed commercial television stations to be 1,387.²⁰⁹ Of this total, 1,258 stations (or about 91 percent) had revenues of \$38.5 million or less, according to Commission staff review of the BIA Kelsey Inc. Media Access Pro Television Database (BIA) on November 16, 2017, and therefore these licensees qualify as small entities under the SBA definition. In addition, the Commission has estimated the number of licensed noncommercial educational television

²⁰⁰ See, 13 CFR § 121.201. The Wired Telecommunications Carrier category formerly used the NAICS code of 517110. As of 2017 the U.S. Census Bureau definition shows the NAICS code as 517311 for Wired Telecommunications Carriers. See, <https://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517311&search=2017>.

²⁰¹ See U.S. Census Bureau, *2012 Economic Census of the United States*, Table No. EC1251SSSZ5, *Information: Subject Series - Estab & Firm Size: Employment Size of Firms: 2012* (517110 Wired Telecommunications Carriers). https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~517110.

²⁰² *Id.*

²⁰³ The term "small entity" within SBREFA applies to small organizations (non-profits) and to small governmental jurisdictions (cities, counties, towns, townships, villages, school districts, and special districts with populations of less than 50,000). 5 U.S.C. §§ 601(4)-(6).

²⁰⁴ U.S. Census Bureau, 2017 NAICS Definitions, "515120 Television Broadcasting," <https://www.census.gov/cgi-bin/sssd/naics/naicsrch?input=515120&search=2017+NAICS+Search&search=2017>.

²⁰⁵ *Id.*

²⁰⁶ 13 CFR § 121.201; 2012 NAICS code 515120.

²⁰⁷ U.S. Census Bureau, Table No. EC1251SSSZ4, *Information: Subject Series - Establishment and Firm Size: Receipts Size of Firms for the United States: 2012* (515120 Television Broadcasting). https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ4/naics~515120.

²⁰⁸ *Id.*

²⁰⁹ Broadcast Station Totals as of December 31, 2017, Press Release (MB Jan. 5, 2018), http://apps.fcc.gov/edocs_public/attachmatch/DOC-3485706998A1.pdf.

stations to be 395.²¹⁰ Notwithstanding, the Commission does not compile and otherwise does not have access to information on the revenue of NCE stations that would permit it to determine how many such stations would qualify as small entities. There are also 2,367 low power television stations, including Class A stations (LPTV) and 3,750 TV translator stations.²¹¹ Given the nature of these services, we will presume that all of these entities qualify as small entities under the above SBA small business size standard.

We note, however, that in assessing whether a business concern qualifies as “small” under the above definition, business (control) affiliations²¹² must be included. Our estimate, therefore, likely overstates the number of small entities that might be affected by our action, because the revenue figure on which it is based does not include or aggregate revenues from affiliated companies. In addition, another element of the definition of “small business” requires that an entity not be dominant in its field of operation. We are unable at this time to define or quantify the criteria that would establish whether a specific television broadcast station is dominant in its field of operation. Accordingly, the estimate of small businesses to which rules may apply does not exclude any television station from the definition of a small business on this basis and is therefore possibly over-inclusive. Also, as noted above, an additional element of the definition of “small business” is that the entity must be independently owned and operated. The Commission notes that it is difficult at times to assess these criteria in the context of media entities and its estimates of small businesses to which they apply may be over-inclusive to this extent.

Radio Broadcasting. This Economic Census category “comprises establishments primarily engaged in broadcasting aural programs by radio to the public. Programming may originate in their own studio, from an affiliated network, or from external sources.”²¹³ The SBA has established a small business size standard for this category, which is: such firms having \$7 million or less in annual receipts.²¹⁴ According to Commission staff review of BIA Advisory Services, LLC’s *Media Access Pro Radio Database* on March 28, 2012, about 10,759 (97%) of 11,102 commercial radio stations had revenues of \$7 million or less. Therefore, the majority of such entities are small entities.

We note, however, that in assessing whether a business concern qualifies as small under the above size standard, business affiliations must be included.²¹⁵ In addition, to be determined to be a “small business,” the entity may not be dominant in its field of operation.²¹⁶ We note that it is difficult at times to assess these criteria in the context of media entities, and our estimate of small businesses may therefore be over-inclusive.

Auxiliary, Special Broadcast and Other Program Distribution Services. This service involves a variety of transmitters, generally used to relay broadcast programming to the public (through translator and booster stations) or within the program distribution chain (from a remote news gathering unit back to

²¹⁰ *Id.*

²¹¹ *Id.*

²¹² “[Business concerns] are affiliates of each other when one concern controls or has the power to control the other or a third party or parties controls or has the power to control both.” 13 CFR § 21.103(a)(1).

²¹³ U.S. Census Bureau, 2007 NAICS Definitions, “515112 Radio Stations”; <http://www.census.gov/naics/2007/def/ND515112.HTM#N515112>.

²¹⁴ 13 CFR § 121.201, NAICS code 515112 (updated for inflation in 2010).

²¹⁵ “Concerns and entities are affiliates of each other when one controls or has the power to control the other, or a third party or parties controls or has the power to control both. It does not matter whether control is exercised, so long as the power to control exists.” 13 CFR § 121.103(a)(1) (an SBA regulation).

²¹⁶ 13 CFR § 121.102(b) (an SBA regulation).

the station). Neither the SBA nor the Commission has developed a size standard applicable to broadcast auxiliary licensees. The closest applicable SBA category and small business size standard falls under Radio Stations and Television Broadcasting.²¹⁷ U.S. Census Bureau data for 2012 show that 2,849 radio station firms operated during that year.²¹⁸ Of that number, 2,806 firms operated with annual receipts of less than \$25 million per year, 17 with annual receipts between \$25 million and \$49,999,999 million, and 26 with annual receipts of \$50 million or more.²¹⁹ For Television Broadcasting the SBA small business size standard is such businesses having \$38.5 million or less in annual receipts.²²⁰ U.S. Census Bureau data show that 751 firms in this category operated in that year.²²¹ Of that number, 656 had annual receipts of \$25,000,000 or less, 25 had annual receipts between \$25,000,000 and \$49,999,999, and 70 had annual receipts of \$50,000,000 or more.²²² Accordingly, based on the U.S. Census Bureau data for Radio Stations and Television Broadcasting, the Commission estimates that the majority of Auxiliary, Special Broadcast and Other Program Distribution Services firms are small.

The Commission estimates that there are approximately 7,604 FM translators and boosters.²²³ The Commission does not collect financial information on broadcast facilities, and the Department of Commerce does not collect financial information on these auxiliary broadcast facilities. We believe that most, if not all, of these auxiliary facilities could be classified as small businesses by themselves. We also recognize that most commercial translators and boosters are owned by a parent station which, in some cases, would be covered by the revenue definition of a small business entity discussed above. These stations would likely have annual revenues that exceed the SBA maximum to be designated as a small business (\$7.0 million for a radio station or \$14.0 million for a TV station). Furthermore, they do not meet the Small Business Act's definition of a "small business concern" because they are not independently owned and operated.²²⁴

Multichannel Video Distribution and Data Service (MVDDS). MVDDS is a terrestrial fixed microwave service operating in the 12.2-12.7 GHz band. The Commission adopted criteria for defining three groups of small businesses for purposes of determining their eligibility for special provisions such as bidding credits. It defined a very small business as an entity with average annual gross revenues not exceeding \$3 million for the preceding three years; a small business as an entity with average annual gross revenues not exceeding \$15 million for the preceding three years; and an entrepreneur as an entity with average annual gross revenues not exceeding \$40 million for the preceding three years.²²⁵ These

²¹⁷ 13 CFR 121.201, NAICS codes 515112 and 515120.

²¹⁸ U.S. Census Bureau, Table No. EC1251SSSZ4, *Information: Subject Series – Establishment and Firm Size: Receipts Size of Firms for the United States: 2012* NAICS Code 515112, https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ4//naics~515112.

²¹⁹ *Id.*

²²⁰ 13 CFR § 121.201; 2012 NAICS code 515120.

²²¹ U.S. Census Bureau, Table No. EC1251SSSZ4, *Information: Subject Series - Establishment and Firm Size: Receipts Size of Firms for the United States: 2012* (515120 Television Broadcasting), https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ4//naics~515120.

²²² *Id.*

²²³ See *FCC News Release*, "Broadcast Station Totals as of March 31, 2018," dated April 9, 2018; <https://docs.fcc.gov/public/attachments/DOC-350110A1.pdf>.

²²⁴ See 15 U.S.C. § 632.

²²⁵ Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range; Amendment of the Commission's Rules to Authorize Subsidiary Terrestrial Use of the 12.2–12.7 GHz Band by Direct Broadcast Satellite Licensees and their Affiliates; and Applications of Broadwave USA, PDC Broadband Corporation, and Satellite Receivers,

(continued....)

definitions were approved by the SBA.²²⁶ On January 27, 2004, the Commission completed an auction of 214 MVDDS licenses (Auction No. 53). In this auction, ten winning bidders won a total of 192 MVDDS licenses.²²⁷ Eight of the ten winning bidders claimed small business status and won 144 of the licenses. Eight of the ten winning bidders claimed small business status and won 144 of the licenses. The Commission also held an auction of MVDDS licenses on December 7, 2005 (Auction 63). Of the three winning bidders who won 22 licenses, two winning bidders, winning 21 of the licenses, claimed small business status.²²⁸

Amateur Radio Service. These licensees are held by individuals in a noncommercial capacity; these licensees are not small entities.

Personal Radio Services. Personal radio services provide short-range, low-power radio for personal communications, radio signaling, and business communications not provided for in other services. Personal radio services include services operating in spectrum licensed under Part 95 of our rules.²²⁹ These services include Citizen Band Radio Service, General Mobile Radio Service, Radio Control Radio Service, Family Radio Service, Wireless Medical Telemetry Service, Medical Implant Communications Service, Low Power Radio Service, and Multi-Use Radio Service.²³⁰ There are a variety of methods used to license the spectrum in these rule parts, from licensing by rule, to conditioning operation on successful completion of a required test, to site-based licensing, to geographic area licensing. All such entities in this category are wireless, therefore we apply the definition of Wireless Telecommunications Carriers (except Satellite), pursuant to which the SBA's small entity size standard is defined as those entities employing 1,500 or fewer persons.²³¹ For this industry, U.S. Census data for 2012 show that there were 967 firms that operated for the entire year.²³² Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.²³³ Thus, under this category and the associated size standard, the Commission estimates that the majority of firms can be considered small. We note, however, that many of the licensees in this category are individuals and not small entities. In addition, due to the mostly unlicensed and shared nature of the spectrum utilized in many of these services, the Commission lacks direct information upon which to base an estimation of the number of

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Ltd. to Provide A Fixed Service in the 12.2–12.7 GHz Band, *Memorandum Opinion and Order and Second Report and Order*, 17 FCC Rcd 9614, 9711, para. 252 (2002).

²²⁶ See Letter from Hector V. Barreto, Administrator, U.S. Small Business Administration, to Margaret W. Wiener, Chief, Auctions and Industry Analysis Division, Wireless Telecommunications Bureau, FCC (Feb. 13, 2002).

²²⁷ See *Multichannel Video Distribution and Data Service Spectrum Auction Closes; Winning Bidders Announced*, Public Notice, 19 FCC Rcd 1834 (2004).

²²⁸ See *Auction of Multichannel Video Distribution and Data Service Licenses Closes; Winning Bidders Announced for Auction No. 63*, Public Notice, 20 FCC Rcd 19807 (2005).

²²⁹ 47 CFR pt. 95.

²³⁰ The Citizens Band Radio Service, General Mobile Radio Service, Radio Control Radio Service, Family Radio Service, Wireless Medical Telemetry Service, Medical Implant Communications Service, Low Power Radio Service, and Multi-Use Radio Service are governed by subpart D, subpart A, subpart C, subpart B, subpart H, subpart I, subpart G, and subpart J, respectively, of Part 95 of the Commission's rules. See generally 47 CFR Part 95.

²³¹ 13 CFR § 121.201, NAICS Code 517312.

²³² U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210 (Jan. 8, 2016). https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~517210.

²³³ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

small entities that may be affected by our actions in this proceeding.

Public Safety Radio Licensees. As a general matter, Public Safety Radio Pool licensees include police, fire, local government, forestry conservation, highway maintenance, and emergency medical services.²³⁴ Because of the vast array of public safety licensees, the Commission has not developed a small business size standard specifically applicable to public safety licensees. The closest applicable SBA category is Wireless Telecommunications Carriers (except Satellite) which encompasses business entities engaged in radiotelephone communications. The appropriate size standard for this category under SBA rules is that such a business is small if it has 1,500 or fewer employees.²³⁵ For this industry, U.S. Census data for 2012 show that there were 967 firms that operated for the entire year.²³⁶ Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.²³⁷ Thus, under this category and the associated size standard, the Commission estimates that the majority of firms can be considered small. With respect to local governments, in particular, since many governmental entities comprise the licensees for these services, we include under public safety services the number of government entities affected. According to Commission records, there are a total of approximately 133,870 licenses within these services.²³⁸ There are 3,121 licenses in the 4.9 GHz band, based on an FCC Universal Licensing System search of March 29, 2017.²³⁹ We estimate that fewer than 2,442 public safety radio licensees hold these licenses because certain entities may have multiple licenses.

IMTS Resale Carriers. Neither the SBA nor the Commission has developed a size standard specifically applicable to IMTS Resale Carriers. Providers of IMTS resale services are common carriers that purchase IMTS from other carriers and resell it to their own customers. The closest applicable SBA category and size standard is for Telecommunications Resellers.²⁴⁰ Under that size standard, such a business is small if it has 1,500 or fewer employees.²⁴¹ U.S. Census Bureau data for 2012 show that 1,341 firms provided

²³⁴ See subparts A and B of Part 90 of the Commission's Rules, 47 CFR §§ 90.1-90.22. Police licensees serve state, county, and municipal enforcement through telephony (voice), telegraphy (code), and teletype and facsimile (printed material). Fire licensees are comprised of private volunteer or professional fire companies, as well as units under governmental control. Public Safety Radio Pool licensees also include state, county, or municipal entities that use radio for official purposes. State departments of conservation and private forest organizations comprise forestry service licensees that set up communications networks among fire lookout towers and ground crews. State and local governments are highway maintenance licensees that provide emergency and routine communications to aid other public safety services to keep main roads safe for vehicular traffic. Emergency medical licensees use these channels for emergency medical service communications related to the delivery of emergency medical treatment. Additional licensees include medical services, rescue organizations, veterinarians, persons with disabilities, disaster relief organizations, school buses, beach patrols, establishments in isolated areas, communications standby facilities, and emergency repair of public communications facilities.

²³⁵ See 13 CFR § 121.201, NAICS code 517312.

²³⁶ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210 (Jan. 8, 2016). https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5//naics~517210.

²³⁷ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with "1000 employees or more."

²³⁸ This figure was derived from Commission licensing records as of June 27, 2008. Licensing numbers change on a daily basis. We do not expect this number to be significantly smaller today. This does not indicate the number of licensees, as licensees may hold multiple licenses. There is no information currently available about the number of public safety licensees that have less than 1,500 employees.

²³⁹ Based on an FCC Universal Licensing System search of March 29, 2017. Search parameters: Radio Service = PA – Public Safety 4940-4990 MHz Band; Authorization Type = Regular; Status = Active.

²⁴⁰ 13 CFR § 121.201, NAICS code 517911.

²⁴¹ *Id.*

resale services during that year.²⁴² Of that number, all operated with fewer than 1000 employees.²⁴³ Thus, under this category and the associated small business size standard, the majority of IMTS resellers can be considered small entities.

Included among the providers of IMTS resale are a number of wireless carriers that also provide wireless telephony services domestically. The Commission classifies these entities as providers of Commercial Mobile Radio Services (CMRS). At present, most, if not all, providers of CMRS that offer IMTS provide such service by purchasing IMTS from other carriers to resell it to their customers. The Commission has not developed a size standard specifically for CMRS providers that offer resale IMTS. For those services subject to auctions, the Commission notes that, as a general matter, the number of winning bidders that qualify as small businesses at the close of an auction does not necessarily represent the number of small businesses currently in service. Also, the Commission does not generally track subsequent business size unless, in the context of assignments or transfers, unjust enrichment issues are implicated.

Wireless Carriers and Service Providers. Neither the SBA nor the Commission has developed a size standard specifically applicable to Wireless Carriers and Service Providers. The closest applicable SBA category and size standard is for Wireless Telecommunications Carriers (except Satellite), which is an entity employing no more than 1,500 persons.²⁴⁴ For this industry, U.S. Census Bureau data for 2012 show that there were 967 firms that operated for the entire year.²⁴⁵ Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.²⁴⁶ Thus under this category and the associated size standard, the Commission estimates that the majority of Wireless Carriers and Service Providers are small entities.

According to internally developed Commission data for all classes of Wireless Service Providers, there are 970 carriers that reported they were engaged in the provision of wireless services.²⁴⁷ Of this total, an estimated 815 have 1,500 or fewer employees, and 155 have more than 1,500 employees.²⁴⁸ Thus, using available data, we estimate that the majority of Wireless Carriers and Service Providers can be considered small.

E. Description of Projected Reporting, Recordkeeping, and Other Compliance Requirements for Small Entities

The amendments being made in this Second Report and Order do not change reporting requirements but may require additional training consistent with industry RF safety program standards regarding compliance with our RF exposure limits for certain transmitting facilities, such as broadcast sites, some wireless base stations,

²⁴² See U.S. Census Bureau, *2012 Economic Census of the United States*, Table No. EC1251SSSZ5, *Information: Subject Series - Estab & Firm Size: Employment Size of Firms: 2012* (517911 Telecommunications Resellers), https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~517911.

²⁴³ *Id.*

²⁴⁴ 13 CFR § 121.201, NAICS codes 517210.

²⁴⁵ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, *Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210*, https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~517210.

²⁴⁶ *Id.* Available census data does not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

²⁴⁷ See Federal Communications Commission, Wireline Competition Bureau, Industry Analysis and Technology Division, Trends in Telephone Service at Table 5.3 (Sept. 2010) (*Trends in Telephone Service*), https://apps.fcc.gov/edocs_public/attachmatch/DOC-301823A1.pdf.

²⁴⁸ See *id.*

and some antennas at multiple transmitter sites. Also, we are clarifying that in order for the occupational/controlled SAR or MPE limits to be used in evaluating compliance for a portable or mobile device, certain conditions must be met that may include placing a visual advisory such as a label on a device that provides a user with specific information on RF exposure. We are also requiring a sample of the advisory and instructional material be filed with the Commission along with the application for equipment authorization.

E. Steps Taken to Minimize Significant Economic Impact on Small Entities, and Significant Alternatives Considered

The RFA requires an agency to describe any significant alternatives that it has considered in developing its approach, which may include the following four alternatives (among others): “(1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance and reporting requirements under the rule for such small entities; (3) the use of performance, rather than design, standards; and (4) an exemption from coverage of the rule, or any part thereof, for such small entities.”²⁴⁹

Report to Congress: The Commission will send a copy of the Second Report and Order, including this FRFA, in a report to be sent to Congress pursuant to the Congressional Review Act.²⁵⁰ In addition, the Commission will send a copy of the Second Report and Order, including this FRFA, to the Chief Counsel for Advocacy of the SBA. A copy of the Second Report and Order and FRFA (or summaries thereof) will also be published in the Federal Register.²⁵¹

²⁴⁹ 5 U.S.C. § 603(c).

²⁵⁰ See 5 U.S.C. § 801(a)(1)(A).

²⁵¹ See 5 U.S.C. § 604(b).

APPENDIX E**List of Commenters to
2013 RF Order and Further Notice¹****COMMENTS**

- (1) American Radio Relay League (ARRL)
- (2) B. Blake Levitt & Henry C. Lai (Levitt/Lai)
- (3) Benjamin Walters on Behalf of City of Portland (Portland)
- (4) Blooston, Mordkofsky, Dickens, Duffy & Prendergast for Part 90 licensees (Private Users)
- (5) Cardiac Rhythm Management Device Committee of the AAMI (AAMI-CRMD)
- (6) Cohen, Dippell and Everist, P.C. (CDE)
- (7) Consumer Electronics Association (CEA)
- (8) Consumers for Safe Cell Phones (CSCP)
- (9) CTIA – The Wireless Association (CTIA)
- (10) David Hubert (Hubert)
- (11) EMF Safety Network
- (12) Fixed Wireless Communications Coalition, Inc. (FWCC)
- (13) Hammett & Edison (H&E)
- (14) International Brotherhood of Electrical Workers (IBEW)
- (15) International Committee on Electromagnetic Safety of the IEEE (IEEE-ICES)
- (16) James Edwin Whedbee (Whedbee)
- (17) Mark Douglas on Behalf of IT'IS Foundation (IT'IS Foundation)
- (18) Marv Wessel on Behalf of Global RF Solutions (Wessel)
- (19) Medtronic, Inc. (Medtronic)
- (20) Mobile Manufacturers Forum (MMF)
- (21) Motorola Solutions, Inc. (Motorola)
- (22) National Association of Broadcasters (NAB)
- (23) Nickolaus E. Leggett (Leggett)
- (24) Nokia Corporation (Nokia)
- (25) PCIA – The Wireless Infrastructure Association and The HetNet Forum (PCIA)
- (26) RF Check, Inc. (RF Check)
- (27) Richard A. Tell (Tell)
- (28) Robert Johnson on Behalf of Narda-East (Narda)
- (29) Site Safe, Inc. (SiteSafe)
- (30) Telecommunications Industry Association (TIA)
- (31) The EMRadiation Policy Institute (EMRPI)
- (32) Utilities Telecom Council (UTC)
- (33) Verizon and Verizon Wireless (Verizon)
- (34) Wi-Fi Alliance

REPLY COMMENTS

- (1) Alarm Industry Communications Committee (AICC)
- (2) AT&T Services Inc. (AT&T)
- (3) City of Boston, Massachusetts and City of Philadelphia, Pennsylvania (Boston & Philadelphia)

¹ Five-hundred sixty-four commenters responded to the request for comment in Notice of Inquiry that accompanied the Report and Order and Further Notice, the bulk of which were brief comments or submissions of redundantly filed studies, reports and other publications reviewed in the Inquiry.

- (4) CTIA – The Wireless Association (CTIA)
- (5) Hammett & Edison (H&E)
- (6) PCIA – The Wireless Infrastructure Association and The HetNet Forum (PCIA)
- (7) Qualcomm Incorporated (Qualcomm)
- (8) Site Safe, Inc. (SiteSafe)
- (9) The EMRadiation Policy Institute (EMRPI)
- (10) Utilities Telecom Council (UTC)
- (11) Verizon and Verizon Wireless (Verizon)
- (12) Wi-Fi Alliance

EX PARTE & LATE-FILED COMMENTS

- (1) CTIA-The Wireless Association (CTIA)
- (2) Hewlett-Packard Company (HP)
- (3) Occupational Safety and Health Administration (OSHA)
- (4) RF Check, Inc. (RF Check)
- (5) Telecommunications Industry Association (TIA)
- (6) Verizon and Verizon Wireless (Verizon)

FCC; Reassessment of Radiofrequency Exposure Limits & Policies,
Notice of Inquiry, 28 FCC Rcd 3498 (2013)

Federal Communications Commission**FCC 13-39**

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

In the Matter of)	
)	
Reassessment of Federal Communications)	ET Docket No. 13-84
Commission Radiofrequency Exposure Limits and)	
Policies)	
)	
Proposed Changes in the Commission's Rules)	ET Docket No. 03-137
Regarding Human Exposure to Radiofrequency)	
Electromagnetic Fields)	
)	

**FIRST REPORT AND ORDER
FURTHER NOTICE OF PROPOSED RULE MAKING
AND
NOTICE OF INQUIRY**

Adopted: March 27, 2013**Released: March 29, 2013****Comment Date: (90 days after date of publication in the Federal Register).****Reply Comment Date: (150 days after date of publication in the Federal Register).**

By the Commission:

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I. INTRODUCTION

1. Periodic review of the government's rules and regulations to ensure they have kept pace with current knowledge and changing needs is an important characteristic of good government, and we

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here will advance the process of providing a comprehensive review and modification, where appropriate, of this Commission's various rules pertaining to the implementation of the National Environmental Policy Act (NEPA) requirements for environmental reviews, specifically those reviews related to health and safety of radiofrequency (RF) emissions from radio transmitters. Our actions herein are intended to ensure that our measures are compliant with our environmental responsibilities and requirements and that the public is appropriately protected from any potential adverse effects from RF exposure as provided by our rules, while avoiding any unnecessary burden in complying with these rules. This document is divided into three parts: a *Report and Order (Order)* and a *Further Notice of Proposed Rulemaking (Further Notice)* in ET Docket No. 03-137, and a *Notice of Inquiry (Inquiry)* in a new docket, ET Docket No. 13-84. In the *Order* we conclude several technical and semantic issues initiated in 2003 that revise and update our regulations implementing NEPA; in the *Further Notice* we propose to further update and revise our procedures and treat all services equally; and in the *Inquiry* we request comment to determine whether our RF exposure limits and policies need to be reassessed. The purpose of the *Order* and *Further Notice* is to advance ET Docket 03-137 with respect to how to demonstrate compliance with NEPA and our RF exposure limits, but that proceeding does not reach the issue of whether our exposure limits are appropriate. Since consideration of the limits themselves is explicitly outside of the scope of ET Docket 03-137, we propose with the *Inquiry* to open a new docket to consider those limits in light of more recent developments. The *Inquiry* is intended to open discussion on both the currency of our RF exposure limits and possible policy approaches regarding RF exposure. We look forward to developing a complete record to determine whether the current rules and policies should remain unchanged, or should be relaxed or tightened.

2. *Order.* In the *Order*, we resolve several issues regarding compliance with our regulations for conducting environmental reviews under NEPA as they relate to the guidelines for human exposure to RF electromagnetic fields. More specifically, we clarify evaluation procedures and references to determine compliance with our limits, including specific absorption rate (SAR) as a primary metric for compliance, consideration of the pinna (outer ear) as an extremity, and measurement of medical implant exposure. We also elaborate on mitigation procedures to ensure compliance with our limits, including labeling and other requirements for occupational exposure classification, clarification of compliance responsibility at multiple transmitter sites, and labeling of fixed consumer transmitters. A summary of significant comments and discussion on topics initiated by the *Notice of Proposed Rulemaking (Notice)*¹ but that do not necessitate changes to or substantively clarify our rules are provided in Appendix H and involve summation of SAR for multiple transmitters, classification of modular devices, spatial averaging methods near fixed transmitters, and local zoning concerns. We defer some decisions on topics initiated by the *Notice* and make new proposals in the *Further Notice*, which extends the *Notice's* scope to encompass specific items that either were raised in comments for the first time or have evolved significantly since the *Notice* was issued, including the categorical exclusion of fixed transmitters.

3. *Further Notice.* In the *Further Notice*, we seek comment on new proposals developed in the course of this proceeding regarding compliance with our guidelines for human exposure to RF electromagnetic fields. Our proposals reflect an effort to provide more efficient, practical, and consistent application of evaluation procedures to ensure compliance with our guidelines limiting human exposure to RF energy from Commission-regulated transmitters and devices. We are proposing to broadly revise and harmonize the criteria for determining whether single or multiple fixed,² mobile,³ or portable⁴ RF

¹ *Notice of Proposed Rule Making (Notice)*, ET Docket 03-137, *Proposed Changes in the Commission's Rules Regarding Human Exposure to Radio frequency Electromagnetic Fields*, 18 FCC Rcd 13187 (2003). A list of commenters is in Appendix G.

² We propose the term "fixed" in the *Further Notice infra* to describe an RF source that is physically secured at one location and is not able to be easily moved to another location while transmitting. Temporary fixed transmitters such as a "cell-on-wheels" (COW) or a temporary fixed earth station (TFES) are considered fixed sources which may be able to be easily moved to another location, but since these types of transmitters are not licensed to transmit while in motion they would also conform to the proposed description of the term "fixed RF source."

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sources are subject to routine evaluation for compliance with the RF exposure limits or are exempted from such evaluations. Additionally, we propose clarifications of evaluation requirements for portable and medical implant devices. We also propose to adopt specific new requirements for signs and barriers at fixed transmitter sites to ensure compliance with public and occupational exposure limits. Further, we propose a clarification of the definition of transient exposure for non-workers exposed at levels up to occupational limits.

4. With the *Further Notice* we make proposals by which we seek to streamline and harmonize many procedures to achieve equal treatment of RF-emitting sources based on their physical properties rather than service categories. Thus, we propose establishing general exemptions from evaluation to determine compliance in place of existing service-specific “categorical exclusions.” These proposed exemptions involve simple calculations to establish whether any further determination of compliance is necessary. Currently, routine evaluations are required for specific rule subparts meeting certain criteria (see Table 1 in section 1.1307(b)(1) and text in (b)(2)).⁵ The new, general exemptions would instead apply to all subparts authorizing RF sources, including some that are not presently listed. Given the trend toward opportunistic spectrum access to allow services to utilize multiple bands of frequencies with various power limits, inclusion of all services is necessary to better ensure compliance with our exposure limits. Simple calculations should reduce the likelihood of requiring unnecessary and burdensome evaluations for low-power portable devices. Additionally, we seek to allow the computation of SAR for evaluation using any valid method to encourage technological development and greater competition in the computational software marketplace.

5. *Inquiry.* We initiate a new proceeding with a *Notice of Inquiry* to determine whether there is a need for reassessment of the Commission radiofrequency (RF) exposure limits and policies. The *Inquiry* focuses on three elements: the propriety of our existing standards and policies, possible options for precautionary exposure reduction, and possible improvements to our equipment authorization process and policies as they relate to RF exposure. We adopted our present exposure limits in 1996, based on guidance from federal safety, health, and environmental agencies using recommendations published separately by the National Council on Radiation Protection and Measurements (NCRP) and the Institute of Electrical and Electronics Engineers, Inc. (IEEE).⁶ Since 1996, the International Commission on Non-Ionizing Radiation Protection (ICNIRP) has developed a recommendation supported by the World Health Organization (WHO), and the IEEE has revised its recommendations several times, while the NCRP has continued to support its recommendation as we use it in our current rules. In the *Inquiry*, we ask whether our exposure limits remain appropriate given the differences in the various recommendations that have developed and recognizing additional progress in research subsequent to the adoption of our existing exposure limits.

6. Since the Commission is not a health and safety agency, we defer to other organizations and agencies with respect to interpreting the biological research necessary to determine what levels are safe. As such, 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. We recognize our responsibility to both protect the public

(Continued from previous page) _____

³ cf. 47 CFR § 2.1091(b) – a mobile device is used in locations other than fixed locations in such a way that a separation distance of at least 20 centimeters is normally maintained. We propose in the *Further Notice infra* the term “separation distance” to be defined as the minimum distance in any direction, from any part of the radiating structure of a transmitting antenna or antenna array, to the body of a nearby person.

⁴ cf. 47 CFR § 2.1093(b) – a portable device is used in locations other than fixed locations in such a way that a separation distance less than 20 centimeters is normally maintained.

⁵ See 47 CFR § 1.1307(b).

⁶ The Standards Association body of the IEEE dealing with standards development for human exposure to electromagnetic energy is called the International Committee on Electromagnetic Safety (ICES).

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from established adverse effects due to exposure to RF energy and allow industry to provide telecommunications services to the public in the most efficient and practical manner possible. In the *Inquiry* we ask whether any precautionary action would be either useful or counterproductive, given that there is a lack of scientific consensus about the possibility of adverse health effects at exposure levels at or below our existing limits. Further, if any action is found to be useful, we inquire whether it could be efficient and practical.

7. In the *Inquiry* we ask questions about several other issues related to public information, precautionary measures, and evaluation procedures. 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. We ask whether the Commission should consistently require either disclosure of the maximum SAR value or other more reliable exposure data in a standard format – perhaps in manuals, at point-of-sale, or on a website. Additionally, we seek comment on appropriate education and outreach to the public on low-level exposure to RF energy from fixed transmitters in the environment. We also inquire about aspects of evaluation procedures to establish whether the standardization process can be improved considering the fast pace at which technology changes.

8. *Environmental Evaluation.* The National Environmental Policy Act of 1969 (NEPA) requires agencies of the Federal Government to evaluate the environmental effects of proposed major federal actions that significantly effect the quality of the human environment.⁷ The Commission's NEPA regulations (47 C.F.R. §§ 1.1301-1.1319) include guidelines for human exposure to RF energy emitted by Commission-regulated transmitters and facilities based on the recommendations of expert agencies and organizations with responsibilities for health and safety.⁸ The regulations and guidelines that govern human exposure to RF radiation prescribe acceptable levels of RF exposure and procedures to demonstrate compliance with applicable RF exposure limits. The rule changes that we adopt in the *Order* and propose in the *Further Notice* do not change the existing RF exposure limits or have a practical effect on human exposure to RF radiation. They consist instead of technical, non-substantive changes in how RF exposure is evaluated and how compliance with the existing RF exposure limit is demonstrated. In reliance on the analysis/recommendations of agencies and organizations with expertise over RF measurement and the health effects from human exposure to RF radiation,⁹ we find that none of the rule changes adopted or proposed herein have potentially significant effects on the quality of the human environment for purposes of NEPA, the regulations of the Council on Environmental Quality ("CEQ")

⁷ National Environmental Policy Act of 1969, as amended, (NEPA) 42 U.S.C. §§ 4321-4335.

⁸ See 47 CFR § 1.1307(b), *Report and Order* in ET Docket 93-62 (Guidelines for Evaluating the Environmental Effects of Radio frequency Radiation), 11 FCC Rcd 15123 (1996); *Second Memorandum Opinion and Order and Notice of Proposed Rule Making* in ET Docket 93-62, 12 FCC Rcd 13494 (1997), *aff'd sub nom*, *Cellular Phone Taskforce v. Federal Communications Commission*, 205 F.3d 82 (2d Cir. 2000).

⁹ See, *Order* ¶¶ 23-26 (revising the rules to allow evaluation of SAR to demonstrate RF compliance for all fixed and mobile RF sources in reliance on a report of the National Council on Radiation Protection and Measurements (NCRP) regarding the comparative safety of SAR and MPE methodologies); *Order* ¶¶ 55-56 (deciding to classify the pinna as an extremity based on the deliberations of the Institute of Electrical and Electronics Engineers (IEEE) (which had included a review of the pinna's tissue composition and recent research regarding the thermophysiology of the tissue when used near various devices) and on the assessment of the Food and Drug Administration (FDA) that the increased deposition of power to the outer ear (due to its treatment as an extremity) is not of significant concern); *Further Notice* ¶¶ 185-203 (relying on a combination of publications from IEEE, NCRP, and expert engineers cooperating with the National Association of Broadcasters (NAB) to develop a proposal for signage and access restriction for compliance with exposure limits at fixed transmitter sites); and *Further Notice* ¶ 196 – Category Four (proposing an option to defer to the Occupational Safety and Health Administration (OSHA) lockout/tagout procedures to ensure human safety near high power transmitters where exposure could exceed ten times the occupational limit).

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(40 C.F.R. Parts 1500-1508), or the Commission's environmental rules.¹⁰ This includes consideration of the pinnae (outer ears) as similar to hands, feet, wrists and ankles in reliance on the expert determinations of IEEE and FDA that this is appropriate for evaluating human exposure to RF radiation and its effects on human health.

9. We also seek comments from the public, from any federal agency with jurisdiction by law or expertise over the environmental impact of human exposure to RF energy, and from expert organizations, regarding the potential environmental impacts, including any cumulative impacts, of the rule changes proposed in the *Further Notice*. Finally, we propose that any NEPA evaluation is premature at this time with respect to the *Inquiry*, which merely seeks to determine whether there is a basis to reevaluate the Commission's RF exposure limits and policies. Such impact will be considered and the need for an environmental assessment (EA) will be evaluated at that time if we decide in the future to adopt new rules in the course of the new docket initiated by the *Inquiry*.

II. BACKGROUND

10. The National Environmental Policy Act of 1969 (NEPA) requires agencies of the Federal Government to evaluate the effects of their actions on the quality of the human environment.¹¹ To meet its responsibilities under NEPA, the Commission has adopted requirements for evaluating the environmental impact of its actions. One of several environmental factors addressed by these requirements is human exposure to RF energy emitted by Commission-regulated transmitters and facilities, and the Commission has adopted rules and guidelines, as required,¹² establishing acceptable levels of such exposure.¹³

11. In its 1996 *Report and Order* and its 1997 *Second Memorandum Opinion and Order* in ET Docket 93-62,¹⁴ the Commission established guidelines for evaluating the environmental effects of radiofrequency radiation. These guidelines include limits for Maximum Permissible Exposure (MPE) and Specific Absorption Rate (SAR), including limits for both whole-body and partial-body exposures, based

¹⁰ This rulemaking, which revises the FCC regulations implementing the National Environmental Policy Act (NEPA), does not require an environmental review under NEPA. The Council on Environmental Quality regulations do not direct agencies to prepare a NEPA analysis or document before establishing Agency procedures (such as this regulation) that supplement the CEQ regulations for implementing NEPA. Agencies are required to adopt NEPA procedures that establish specific criteria for, and identification of, three classes of actions: those that normally require preparation of an environmental impact statement; those that normally require preparation of an environmental assessment; and those that are categorically excluded from further NEPA review (40 CFR 1507.3(b)). Categorical exclusions are one part of those agency procedures, and therefore establishing categorical exclusions does not require preparation of a NEPA analysis or document. Agency NEPA procedures are procedural guidance to assist agencies in the fulfillment of agency responsibilities under NEPA, but are not the agency's final determination of what level of NEPA analysis is required for a particular proposed action. The requirements for establishing agency NEPA procedures are set forth at 40 CFR 1505.1 and 1507.3. The determination that establishing categorical exclusions does not require NEPA analysis and documentation has been upheld in *Heartwood, Inc. v. U.S. Forest Service*, 73 F. Supp. 2d 962, 972-73 (S.D. Ill. 1999), *aff'd*, 230 F.3d 947, 954-55 (7th Cir. 2000). Furthermore, having consulted with, and relied on the recommendations of federal agencies and organizations with expertise in measuring RF exposure and evaluating the significance of exposure to RF radiation on human health, we find that the rule changes adopted or proposed herein will not have a significant environmental effect.

¹¹ National Environmental Policy Act of 1969, as amended, (NEPA) 42 U.S.C. §§ 4321-4335.

¹² See footnote 176, *infra*.

¹³ See 47 CFR § 1.1307(b).

¹⁴ *Report and Order* in ET Docket 93-62 (Guidelines for Evaluating the Environmental Effects of Radio frequency Radiation), 11 FCC Rcd 15123 (1996); *Second Memorandum Opinion and Order and Notice of Proposed Rule Making* in ET Docket 93-62, 12 FCC Rcd 13494 (1997).

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on criteria published by the National Council on Radiation Protection and Measurements (NCRP)¹⁵ and by the American National Standards Institute/Institute of Electrical and Electronics Engineers, Inc. (ANSI/IEEE).¹⁶ The 1996 *Report and Order* also established “categorical exclusions” from routine environmental evaluation for RF exposure for radio stations and existing facilities, which have technical characteristics that minimize the likelihood of exceeding our guidelines.

12. In its 2003 *Notice* in this proceeding,¹⁷ the Commission noted that some transmitters and devices categorically excluded from routine environmental evaluation for RF compliance may be inappropriately excluded and that certain exclusion criteria can be harmonized to govern similar facilities in different services. In addition, it proposed to revise certain rules to clarify the responsibilities of licensees and grantees and to ensure compliance with its RF exposure rules in a more practical, consistent, and efficient manner. Accordingly, the Commission made several evaluation requirement proposals related to compliance with the limits for human exposure from fixed, mobile, and portable transmitters. The Commission did not propose to modify the exposure limits themselves, which were developed in conjunction with other federal agencies that have primary expertise in health and safety.¹⁸ Consistent with prior documents in this proceeding, this *Order* and the companion *Further Notice* herein do not invite comment regarding the exposure limits themselves; however, the exposure limits are subject to review in a new proceeding, beginning with the *Inquiry*, which is the final part of this document.

13. As discussed in further detail in the *Inquiry infra*,¹⁹ the International Commission on Non-Ionizing Radiation Protection (ICNIRP) published exposure guidelines in 1998,²⁰ and the IEEE published a major revision to its RF exposure standard in 2006.²¹ Every IEEE standard is subjected to review at least once every five years for revision or reaffirmation, so either a new revision of IEEE Std C95.1 or a reaffirmation of the latest version is expected in the near future. Having already released its latest guidelines on low frequency fields in 2010,²² we anticipate that ICNIRP may also release a revision

¹⁵ National Council on Radiation Protection and Measurements (NCRP), *Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields*, NCRP Report No. 86, Sections 17.4.1, 17.4.1.1, 17.4.2, 17.4.3 and 17.4.5, copyright 1986 by NCRP, Bethesda, Maryland 20814. The National Council on Radiation Protection and Measurements is a nonprofit corporation chartered by Congress in 1964 primarily to collect, analyze, develop, and disseminate information on radiation protection.

¹⁶ American National Standards Institute (ANSI), *IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*, ANSI/IEEE Std C95.1-1992, Sections 4.1 and 4.2, copyright 1991 by the Institute of Electrical and Electronics Engineers, Inc. (IEEE), New York, New York 10017. IEEE is a non-profit international professional association of electrical and electronics engineers involved in technology standards development. ANSI is a private, not-for-profit organization that oversees its members and constituents throughout the process of standards development.

¹⁷ *Notice of Proposed Rule Making*, ET Docket 03-137, *Proposed Changes in the Commission's Rules Regarding Human Exposure to Radio frequency Electromagnetic Fields*, 18 FCC Rcd 13187 (2003). A list of commenters is in Appendix G.

¹⁸ *Id.* at 13189.

¹⁹ See ¶¶ 211-215 *infra*.

²⁰ International Commission on Non-Ionizing Radiation Protection (ICNIRP), *Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (Up to 300 GHz)*, Health Physics 74 (4): 494-522, 1998. ICNIRP is an international non-profit-making body of independent scientific experts addressing the possibility of adverse effects on human health of exposure to non-ionizing radiation.

²¹ Institute of Electrical and Electronics Engineers, Inc. (IEEE), *IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*, IEEE Std C95.1-2005, copyright 2006 by the Institute of Electrical and Electronics Engineers, Inc. (IEEE), New York, New York 10016-5997.

²² International Commission on Non-Ionizing Radiation Protection (ICNIRP), *Guidelines for Limiting Exposure to time-Varying Electric and Magnetic Fields (1 Hz - 100 kHz)*, Health Physics 99(6): 818-836, 2010.

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of its RF standard in the near future. These more recent international exposure standards activities have a fundamentally similar basis in protecting against established adverse health effects due to tissue heating. However, it is noteworthy that both IEEE and ICNIRP localized SAR limits are 2.0 W/kg averaged over 10 grams as opposed to our existing localized SAR limit of 1.6 W/kg averaged over 1 gram. We also note that ICNIRP specifies slightly more restrictive MPE limits for continuous exposure than the present Commission guidelines permit at some frequencies. Also we have observed ongoing international health-related activity in this area, with the World Health Organization (WHO) initiating its electromagnetic fields (EMF)²³ program in 1996²⁴ and continuing its broad efforts in this area with its more recent publication of model legislation for national entities,²⁵ as well as the International Agency for Research on Cancer (IARC) classifying both RF and ELF fields as possibly carcinogenic to humans.²⁶

III. REPORT AND ORDER

14. This *Order* resolves issues raised in the *Notice*, that have already experienced a notice and comment period in ET Docket 03-137, and for which an adequate record exists to support a decision. Generally, this *Order* seeks to resolve certain evaluation matters involving the determination of potential exposure levels by calculation or measurement and certain mitigation matters involving post-evaluation procedures to ensure exposure limits are not exceeded (such as labels, signs, barriers, enforcement, and occupational issues). Currently, categorical exclusion from Environmental Assessment with respect to RF exposure can be achieved by either: (1) demonstrating compliance with our RF exposure limits,²⁷ or (2) falling into a category based on proximity and power level.²⁸ In the *Further Notice*, we briefly summarize our original proposals and comments (a more detailed summary can be found in Appendix H) initiated by the *Notice* dealing with categorical exclusion and propose new general exemption²⁹ criteria based on proximity, frequency, and power that will streamline the determination of whether preparation of a routine RF evaluation is necessary.

15. As explained in the next paragraph and in the sections which follow, our rule revisions are intended to provide applicants with alternative methods of showing that they comply with the RF exposure limits, which could reduce the costs of applying for licenses and grants without relaxing the current protections against excessive RF exposure. For example, we establish a definitive basis in SAR

²³ In the context of the WHO, EMF encompasses the frequency range of 0 to 300 GHz, including extremely low frequency (ELF) fields.

²⁴ See http://www.who.int/peh-emf/project/EMF_Project/en/index.html.

²⁵ See World Health Organization (WHO), *Model Legislation for Electromagnetic Fields Protection*, Articles 2.1, 7.4 and 7.5, 2006, ISBN 978 92 4 159432 5, http://www.who.int/peh-emf/standards/EMF_model_legislation_2007.pdf.

²⁶ See *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Volume 80, Non-Ionizing Radiation, Part 1: Static and Extremely Low-Frequency (ELF) Electric and Magnetic Fields*, World Health Organization International Agency for Research on Cancer, IARC Press, 2002. See also *Carcinogenicity of Radiofrequency Electromagnetic Fields*, Vol. 12, Issue 7, pp. 624-626, WHO IARC Monograph Working Group, Lancet Oncology, 2011.

²⁷ See §§ 1.1306(b)(3) and 1.1307(b).

²⁸ See §§ 1.1307(b)(1) and 1.1307(b)(2).

²⁹ The Commission agrees with comments by BSL (See BSL Comments at 2-7) regarding the proper usage of the term “categorical exclusion.” Thus, we are using the terminology “exemption” from determination of compliance to refer to categorical exclusion based on proximity and power in the *Further Notice* proposals. However, in this *Order*, we continue to use “categorical exclusion” in order to be consistent with the *Notice*. Finally, we retain the term “categorical exclusion” as it applies to the compliance-based meaning that preparation of an Environmental Assessment is required if an action would result in human exposure in excess of our limits (§ 1.1306(b)(3)) or for other matters listed in § 1.1307(a).

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for standard analysis procedures to reliably determine compliance, and we clarify our requirements near RF transmitters, seeking to reduce costs for licensees and grantees where possible, while maintaining full compliance with our RF exposure guidelines to ensure safety.³⁰

16. In this *Order*, we adopt rules explicitly permitting licensees and grantees to demonstrate that they comply with the Commission's RF exposure rules based on specific absorption rate (SAR) in lieu of maximum permissible exposure (MPE) for fixed and mobile transmitters. Providing an additional option for parties to demonstrate that they comply with the RF exposure limits could reduce those parties' expenses in some cases. Additionally, in the *Order*, we classify the outer ear as an extremity based on similarities to other parts of the body such as the hands and feet, which are already classified as extremities. This reclassification of the outer ear as an extremity is consistent with health agency comment and industry standards and should eliminate unnecessary compliance costs that could occur under alternative evaluation schemes.

17. We also in this *Order* more clearly specify the applicability requirements for occupational exposure limits at fixed transmitter sites and better define labeling requirements for occupational users of portable and mobile devices. We finally discuss, clarify, and reaffirm our rules dealing with responsibility at sites with multiple fixed transmitters, as well as our rules on appropriately labeling fixed transmitters installed at consumers' homes.

A. Evaluation of RF Exposure

18. Currently, "routine environmental evaluation" is described in our rules as "determination of compliance" with our exposure limits, which could be achieved by either computation or measurement.³¹ Methods for evaluation of compliance include computation and measurement of field strength, power density, or specific absorption rate (SAR), depending on the RF source. The guidelines for evaluation of compliance with our human exposure limits can be found in OET Bulletin 65.³²

19. The topics regarding evaluation included in this *Order* are: use of SAR as a primary metric over power density or field strength at frequencies below six gigahertz,³³ citation to our policies on evaluation procedures in our rules,³⁴ classification of the pinna (outer ear) as an extremity,³⁵ and use of SAR measurements in the Part 95 MedRadio devices to be consistent with Part 1.³⁶ As mentioned previously,³⁷ a summary of significant comments and discussion on topics initiated by the *Notice* but that do not necessitate changes to our rules is provided in Appendix H.

1. Primacy of Specific Absorption Rate (SAR) over Power Density or Field Strength below 6 GHz

20. *Summary.* In the *Notice*, we proposed to allow evaluation based on specific absorption rate (SAR) in lieu of maximum permissible exposure (MPE) for fixed and mobile transmitters, since the

³⁰ In the *Order* and *Further Notice* we deal only with application of our existing exposure limits; however, in the *Inquiry* we broach the subject of efficacy and currency of our exposure limits.

³¹ See §§ 1.1307(b)(1) and 1.1310.

³² OET Bulletin 65, Edition 97-01, August 1997.

³³ See section III. H. of the *Notice*.

³⁴ *Id.*

³⁵ See section III. E. of the *Notice*.

³⁶ See section III. J. of the *Notice*.

³⁷ See para. 2 *supra*.

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MPE limits are derived from the SAR limits. Comments received were generally supportive, and we here incorporate SAR as a primary exposure limit in section 1.1310 of our rules. (Note that this consideration refers only to fixed and mobile transmitters; SAR evaluation continues to be required for portable transmitters.)

21. *Original Proposals.* In the *Notice*, we explained that the IEEE standards and NCRP criteria used in deriving the Commission's RF exposure criteria are based on allowed levels ("basic restrictions") for SAR.³⁸ Because of the impracticality of measuring for SAR within the body at a distance from a transmitter (e.g., on the ground near a television transmitting antenna or a cellular base station antenna), these SAR levels were used by the standard-setting bodies to derive reference levels for MPE that are expressed as field strength and/or power density. These parameters are readily measureable with common instrumentation in free-space at any location that may be occupied by a body. As a consequence, when section 1.1310 was adopted it referred only to the MPE values for field strength and/or power density but not to the underlying SAR values, as SAR evaluation was not a consideration for fixed or mobile transmitters. In the *Notice*, we noted that in light of continuing developments in practical SAR evaluation this section should also specify the SAR values from which the MPE values were derived, and we proposed to add this specification.³⁹ We also proposed to amend section 1.1310 to reference the underlying whole-body and/or partial-body SAR values for exposure criteria and to allow for evaluation of SAR in lieu of power density or field strength for demonstrating compliance.⁴⁰

22. *Comments.* Almost all of the parties that responded to this proposal supported it.⁴¹ Motorola, Inc. (Motorola) pointed out that SAR is the basic quantity used to derive the Commission's exposure guidelines and, therefore, should be allowed as a compliance metric. Motorola and others also agreed that simple compliance based on MPE values may overstate the actual RF energy absorption of persons near transmitters and that SAR is a more accurate indicator of human exposure. The only commenter expressing reservations regarding our proposal was The EMR Network (EMR Network),⁴² which contended that SAR should only be used for evaluating compliance in this context when it results in "greater safety" than an MPE measurement.

23. *Decision.* We will amend our rules as proposed to reference the underlying whole-body and partial-body exposure limits for SAR and to allow evaluation of SAR in lieu of power density or field strength for demonstrating compliance of all fixed and mobile RF sources below 6 GHz.⁴³ (SAR evaluation continues to be required as the only acceptable compliance metric for portable devices below 6 GHz.⁴⁴) Accordingly, we will henceforth consider both MPE and SAR to be appropriate measures for determining compliance, where applicable. Although SAR evaluation has a more direct relationship to our exposure limits below 6 GHz, it can be difficult to evaluate in some instances, and so standards bodies derived MPE as an alternative, essentially equivalent method, that is more practical to use in some situations. In so doing, in order to ensure that such measurements resulted in compliance with the SAR limits, conservative measurement methods were specified. Entities can continue to use derived MPE evaluation methods for fixed and mobile RF sources where appropriate, as long as compliance with both the whole-body and localized SAR limits are ensured. Although evaluation using either MPE or SAR

³⁸ *Notice*, 18 FCC Rcd at 13204-05, ¶ 44.

³⁹ *Id.*

⁴⁰ *Id.*

⁴¹ See Cingular comments at 15; Dell comments at 3; Ericsson comments at 8; Motorola comments at 14-15; Nokia comments at 8; T-Mobile comments at 15; TIA comments at 13.

⁴² See EMR Network comments at 4.

⁴³ See § 1.1310 in Appendix A *infra*.

⁴⁴ See § 2.1093.

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may result in somewhat different distances for the same source to achieve compliance with the measurement metric, the practical effect of those differences will be negligible.

24. As SAR is the basic restriction developed to safeguard human health from the effects of RF emissions, compliance with the SAR guidelines directly will provide *ipso facto* the protection specified in our RF safety guidelines.⁴⁵ Additionally, as evaluation under either method provides for compliance with our RF safety guidelines, both methods ensure “safety,” the essence of our threshold limit is that any exposure below the limit is protective of humans⁴⁶ and there is no “greater safety” associated with selecting whichever evaluation is more restrictive in any given circumstance, as suggested by EMR Network’s argument.⁴⁷ The question of whether our current guidelines provide for the public’s safety from possible health hazards from RF exposure as a general matter is a separate consideration, and that issue is addressed in our *Inquiry, infra*. Accordingly, as either method will constrain RF emissions to levels consistent with our SAR guidelines, this change will not have environmental consequences. We observe that we already rely on one set of exposure limits over another in some cases, as we require evaluation using SAR in lieu of MPE at separation distances less than 20 centimeters and frequencies below 6 GHz and we rely on MPE in lieu of SAR at frequencies above 6 GHz.⁴⁸ Below 6 GHz, we clarify here that SAR is primary to MPE at any distance, considering the result of MPE evaluation could differ from that of SAR evaluation under certain circumstances. Since MPE limits were derived from the whole-body SAR limits assuming uniform whole-body exposure – not localized or non-uniform exposure – consideration of localized SAR limits in addition to whole-body SAR becomes necessary at distances less than 20 centimeters. However, for whole-body exposure at distances greater than 20 centimeters and below 6 GHz, we continue to consider spatial-averaging techniques as sufficient to use along with MPE to demonstrate compliance with both localized and whole-body SAR limits in non-uniform fields in most cases.⁴⁹

25. The derived MPE limits are practical and adequate under certain conditions, including sufficient separation distance from the source. However, we note that accepted, generic procedures for determining SAR throughout the range of varied circumstances have not been developed. Accordingly, the acceptability of the procedures that a proponent of an RF source uses to calculate the relevant SAR values must, at this point, be assessed on an *ad hoc* basis. More specifically, in a compliance showing that uses SAR, the proponent must demonstrate that the device was evaluated in all applicable operating configurations and exposure conditions, considering both whole- and partial-body limits and both near- and far-field situations. In view of the above, we find that section 1.1310 should reference both the basic SAR guidelines as well as the derived MPE reference levels. We will continue to allow MPE for demonstration of compliance with our limits under the conditions we have allowed in the past as a matter of choice for entities who may wish to trade the occasionally more restrictive results for the relative ease of application in some cases. Applicants that wish to do so should be allowed to perform a SAR evaluation in lieu of determining power density or field strength, but only where the applicant

⁴⁵ See Sections 17.3, *Development of the SAR Exposure Criteria*, NCRP Report No. 86, *Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields*, which describes whole-body SAR as the “fundamental criterion.”

⁴⁶ More completely, given the safety factor built into our threshold limit, any exposure below or near the limit is considered to be protective of humans.

⁴⁷ See Sections 17.4.1 and 17.4.2, NCRP Report No. 86, *Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields*.

⁴⁸ Above 6 GHz, we rely on MPE instead of SAR because energy deposition would occur primarily on the surface of the skin, so an SAR average over a one-centimeter depth of tissue (corresponding to a 1-g cube) would not be appropriate.

⁴⁹ We sought comment in the *Notice* on spatial averaging techniques, and a discussion on the comments we received is included in Appendix H *infra*.

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demonstrates the use of valid procedures and conditions (e.g., in supplemental technical information) for establishing the accuracy, relevance, and enforceability of the SAR evaluation. However, where the compliance of a device or transmitter installation is based on MPE assessment and is later found to be noncompliant with the MPE requirement, *post factum* SAR evaluation showing compliance with the SAR guidelines will not be allowed as a response to enforcement action. That is, licensees and others desiring to base compliance on SAR values must choose to do so and document compliance during licensing, renewal, or equipment authorization, not in response to a Commission enforcement action based on non-compliance with the MPE limits. Accordingly, we are amending section 1.1310 to reference the underlying whole-body and partial-body SAR values for exposure criteria, allow for evaluation of SAR in lieu of power density or field strength when demonstrating compliance at frequencies below 6 GHz, and require that the demonstration of compliance contain sufficient information for the Commission to conclude that the evaluation was conducted using technically supportable methods and exposure conditions in a manner that permits independent assessment. In conjunction with this change, while we consider the likelihood of such an occurrence to be quite small, we make clear here that SAR evaluation *post factum* after a violation of the MPE limits is determined cannot be used to undermine enforceability of the MPE limits.

26. The addition of an option to use SAR values for demonstrating RF exposure compliance should not result in any increased costs since the current option of conducting an MPE-based evaluation will remain available and can be used as appropriate if, in a particular instance, the applicant determines that the costs of using the new option are unacceptably higher. We expect that industry will be able to determine whether the option for SAR evaluation decreases the expected net compliance cost compared to MPE evaluation on a case-by-case basis. SAR evaluation could result in smaller required separation distances between people and antennas than those required based on MPE while still ensuring compliance because it would reduce error in compliance distance determination.⁵⁰ However, SAR evaluation is associated with higher analytical and administrative costs, so the SAR option will decrease net cost in those cases where decreased mitigation costs exceed SAR compliance costs.

27. Since SAR evaluation costs apply only once to each unique device or antenna configuration but mitigation costs are ongoing and apply to each individual manufactured device or installation, even a small decrease in repeated mitigation costs could easily offset the cost of SAR evaluation. These cost considerations should generally apply to both fixed and mobile transmitters. International standard procedures have been developed to make use of SAR evaluation for one subset of radiators – wireless base station antennas.⁵¹ Many common low power transmitters classified as mobile (> 20 cm), such as Wi-Fi and cordless phone bases, smart meter transmitters, or radio-frequency identification (RFID) readers may be able to show SAR compliance intrinsically on contact such that an SAR evaluation may eliminate unnecessary or overly restrictive grant conditions, especially if adequate non-conductive covers, coatings or radomes are used to maintain a specific separation distance necessary for compliance. Currently, grants of equipment authorization for such devices normally state that a 20 cm separation distance should be conservatively maintained, but this may be unnecessary if SAR data were submitted. However, collocated transmitting antennas would have to be considered in SAR evaluations as appropriate which may diminish the practical use of SAR evaluation.

⁵⁰ We reiterate here that any such reduction in separation distance, as it would only reduce superfluous separation, would not affect compliance with our guidelines or environmental impact.

⁵¹ See International Electrotechnical Commission, *Determination of RF field strength and SAR in the vicinity of radiocommunication base stations for the purpose of evaluating human exposure*, 62232 ed. 1.0, TC/SC 106, 2011, <http://www.iec.ch/>.

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2. Technical Evaluation References in Rules

28. *Summary.* We intend to discontinue the Office of Engineering and Technology (OET) Bulletin 65 Supplement C, an informational document which provides guidance and general statements of our policies with regard to our RF exposure limits for portable and mobile devices, since OET has been able to provide more up-to-date information for these devices in its Knowledge Database (KDB).⁵² Thus, we amend section 2.1093(d)(3) to reference the KDB which will continue to be frequently updated to reflect our most recent guidance and policies on evaluating compliance with our RF exposure limits.

29. *Original Proposals.* As discussed in the *Notice*, specific guidance on acceptable procedures for evaluating compliance of portable devices with the Commission's SAR guidelines is provided in Supplement C of FCC OET Bulletin 65, issued and updated by the Commission's Office of Engineering and Technology, and our rules reference Supplement C where SAR measurement is implicated.⁵³ These procedures generally reflect those that have been developed for SAR analysis by an expert committee of the IEEE.⁵⁴

30. The references to Supplement C in our rules are understood to incorporate that edition of Supplement C extant at the time the particular rule was adopted. This results eventually in reference to outdated protocols and procedures and can result in confusion as to what constitutes acceptable procedures for evaluating SAR for portable devices. We must follow formal rulemaking procedures to update outdated references in our rules, however slight or obvious. Accordingly, we proposed to revise our rules so that they generically reference the most recent edition of Supplement C. We made this proposal to eliminate confusion about our recommended procedures and so that updates to our guidelines for device evaluation can be accommodated more quickly through revisions in Supplement C. We also proposed to delete the reference in section 2.1093(d)(3) of our rules to IEEE Standard C95.3-1991, which is outdated, and for mobile devices we proposed to add a similar reference to OET Bulletin 65 in the introductory text of section 2.1091(d). Additionally, we proposed to amend section 2.1093 to indicate that computational modeling may be used to demonstrate compliance with the SAR limits only if supported by adequate documentation.

31. *Comments.* Many of the commenters on this issue generally agreed that Supplement C is an appropriate document for providing guidance on acceptable procedures for evaluating SAR from wireless devices.⁵⁵ However, some commenters preferred that our rules refer instead to specific standards developed by expert organizations. Motorola, for example, was concerned that such a reference could result in a loss of "flexibility" in the guidelines contained in Supplement C and that any subsequent changes to Supplement C would have to occur through a lengthy rulemaking process.⁵⁶ Motorola urged

⁵² See <https://apps.fcc.gov/oetcf/kdb/>. OET publishes technical guidance documents on their Knowledge Database (KDB) website. This guidance is developed by the staff based on individual inquiries for clarification of test procedures for new technology as well as discussions with test labs and Telecommunications Certification Bodies. The KDB documents do not necessarily represent the only acceptable methods for measuring RF exposure or emissions, and are not binding on the Commission or any interested party. Rather, they represent procedures that have proven useful in specific cases and situations, and which may be helpful to an applicant in settling on testing procedures that it will use to make an RF emissions exposure determination regarding its own unique device or technology.

⁵³ See, e.g., §§ 2.1091 and 2.1093 of our rules. 47 C.F.R. §§ 2.1091, 2.1093.

⁵⁴ IEEE Standards Coordinating Committee 34 (SCC34), Subcommittee 2. *Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques*. IEEE Standard 1528-2003.

⁵⁵ See Cingular comments at 15; Cisco comments at 12-13; Ericsson comments at 7; IEEE 802 comments at 7; PalmOne reply comments at 3; Qualcomm comments at 7-8; TIA comments at 10-11; Wi-Fi comments at 10.

⁵⁶ See Motorola comments at 9-12.

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that the Commission instead reference the specific standards developed by committees of the Institute of Electrical and Electronics Engineers (IEEE) and International Electrotechnical Commission (IEC). The Cellular Telecommunications and Internet Association (CTIA) also supported incorporating references to standards of outside expert organizations, such as the IEEE and IEC, rather than references to a document that, CTIA said, is based on some, but not all, internationally-accepted testing techniques.⁵⁷ CTIA pointed out that Supplement C is intended only to provide guidance and that Supplement C clearly states that it is not intended to establish “mandatory procedures.”

32. The Telecommunications Industry Association (TIA) supported a general reference to the IEEE recommendations that are the basis for the Commission requirements.⁵⁸ It strongly recommended that the Commission rely on international consensus standards. TIA submitted that as IEEE refines SAR evaluation guidelines, they can be incorporated into Supplement C. TIA was concerned that a general reference to Supplement C would seem to indicate that the Commission would modify evaluation requirements without consultation with relevant expert IEEE committees. Further, TIA contended that Supplement C provides only limited direction. Cisco Systems, Inc. (Cisco) and Ericsson⁵⁹ supported the proposal to reference the most current edition of Supplement C in the rules, and they commented that this would allow the Commission to rapidly incorporate new evaluation procedures without involving rulemaking procedures.⁶⁰ However, Ericsson also believed it is important that the Commission incorporate the most appropriate international standards and practices developed by the IEEE, IEC, and the European Committee for Electrotechnical Standardization (CENELEC).

33. APREL⁶¹ agreed in principle that the Commission should include reference to internationally accepted standards, but it commented that reference should be made to all standards that may have scientific merit, not just those of the IEEE and IEC.⁶² Nokia suggested that the Commission’s rules contain a reference to the IEEE standard, as modified by the relevant IEEE committee, to ensure that the rule reference always points to the most current evaluation methods.⁶³ Nokia, Inc. (Nokia) also urged the Commission to reference the new IEC standard for evaluating SAR from “body worn” wireless devices, once this standard is finalized.

34. PalmOne saw no practical difference between the Commission’s proposal and the “accepted policy of today.”⁶⁴ PalmOne supported our proposal, provided that the Commission continues to allow all relevant standards, such as those of the IEEE and the IEC, to be used, a view also expressed by IEEE 802⁶⁵ and Wi-Fi Alliance (Wi-Fi).⁶⁶ PalmOne noted that a rule reference only to Supplement C will simplify the evaluation process by allowing manufacturers to reference one document as containing “preferred guidelines,” while still allowing them to consult other standards if required. PalmOne agreed with Cisco’s comments supporting referencing Supplement C but, like Cisco, urged caution against revising the document too rapidly without sufficient notice.

⁵⁷ See CTIA comments at 11-12.

⁵⁸ See TIA comments at 10-11.

⁵⁹ Ericsson, Inc., and SONY Ericsson Mobile Communications, Inc. (Ericsson).

⁶⁰ See Cisco comments at 12-13; Ericsson comments at 7.

⁶¹ APREL Laboratories and Spectrum Sciences Institute (APREL).

⁶² See APREL comments at 4.

⁶³ See Nokia comments at 7.

⁶⁴ See PalmOne reply comments at 3.

⁶⁵ Institute of Electrical and Electronics Engineers, Local and Metropolitan Area Networks Standards Committee IEEE 802 (IEEE 802).

⁶⁶ See IEEE 802 comments at 7; Wi-Fi comments at 10.

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35. Cingular suggested that public comment should be obtained prior to revising Supplement C.⁶⁷ However, PalmOne disagreed and believed that this would negate the intended benefit of the Commission quickly revising procedures and policies as new advances are made. Qualcomm, Inc. (Qualcomm) supported the proposal and urged that guidelines for testing of transmitter modules also be formally incorporated into Supplement C.⁶⁸

36. Motorola disagreed with our proposal to amend section 2.1093 to indicate that computational modeling may be used to demonstrate compliance only if supported by adequate documentation.⁶⁹ Motorola maintained that this qualification is not necessary and is redundant since section 2.1093(c) already requires that technical information must be submitted upon request. Rather than placing this language in the rules, Motorola suggested the Commission give consideration to implementing a “declaration of conformity”⁷⁰ procedure for portable and mobile devices.

37. *Decision.* We intend to discontinue use of Supplement C as an informative reference for evaluation of mobile and portable devices. Thus, instead of adopting a generic reference to Supplement C in appropriate rule sections, we will reference the Office of Engineering and Technology (OET) Laboratory Division Knowledge Database (KDB) to provide current guidance and policies on acceptable procedures for evaluating wireless devices. This will provide us with the ability to promptly update this guidance as the work of expert bodies and other research indicate that changes are appropriate. Contrary to Motorola’s concern, the purpose of this change is to allow quicker modifications to our policies pertaining to evaluation procedures and processes.⁷¹

38. With regard to some commenters’ concerns that we should reference expert bodies and international standards, we fully intend to continue to use the KDB to provide guidance on techniques and methodologies recommended by internationally and domestically accepted expert standards bodies, such as the IEEE and the IEC, to the extent that their standard procedures ensure compliance with our exposure limits. Commission staff will continue to be active participants on the committees that develop these very standards. However, contrary to the position of commenters that would have us directly incorporate the standards of other bodies as our policy, it is the responsibility of this Commission to ensure compliance with our exposure limits, and thus this agency will make the ultimate judgment as to whether we should include them. Also, guidance on evaluation methodologies and protocols might not be completely addressed by individual independent standards. By issuing our own guidance on our policies, we can communicate how best to incorporate the input of all relevant expert standards, readily use the most appropriate elements of conflicting outside standards, and also provide any additional information that may be helpful for evaluation. Additionally, this approach provides us with the flexibility necessary to implement certain changes to our policies in advance of universal agreement, when it becomes apparent that such changes are warranted. For example, the FCC Laboratory has continued to establish further policies on test procedures for new technologies (such as LTE and WiMax devices) and for specific products (such as handsets and other consumer devices with multiple transmitters) in the KDB that lack descriptive test procedures in existing independent measurement standards.

39. As pointed out by CTIA, the Introduction to Supplement C states that the document is not intended to establish mandatory procedures, and other methods and procedures may also be acceptable if based on sound engineering practice. By the same token, each new device and technology submitted for

⁶⁷ See Cingular comments at 15.

⁶⁸ See Qualcomm comments at 7-8.

⁶⁹ See Motorola comments at 11-12.

⁷⁰ See 47 CFR § 2.906.

⁷¹ Rulemaking procedures are obviated by the Administrative Procedure Act for interpretative guidance and general statements of our policy. See Administrative Procedure Act, 5 U.S.C. § 553(b)(A). Exceptions to rulemaking include “interpretative rules, general statements of policy, or rules of agency organization, procedure, or practice.”

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our approval requires its own showing and is evaluated on its own merits; use of a recommended evaluation procedure does not automatically guarantee acceptance of the device or technology if, in the given case, such procedure proves inadequate or otherwise unacceptable. This flexibility continues to be the case with our OET Bulletins and their Supplements, and information contained in the KDB, with our goal being to provide the most up-to-date guidance for evaluation of RF exposure from portable and mobile devices, while making prospective grantees aware of the techniques and methodologies that we recommend and believe will best ensure compliance with our RF exposure limits, albeit without elevating such recommendations to the level of a guarantee. The information contained in the KDB also provides the framework and guidelines for Telecommunications Certification Bodies (TCBs) to approve evolving products and technologies. Parties will continue to be able to demonstrate compliance with our rules by other means if based on sound validated methodologies. Given the increased currency of the KDB compared to Supplement C, the retirement of the latter should address the concerns of TIA and others regarding the adequacy of the Commission's supplementary information providing guidance on evaluation.

40. Another purpose of our change in policy to reference the KDB procedures in lieu of Supplement C is to eliminate any ambiguity about procedures that the FCC Laboratory has found acceptable. Recent technology changes have outpaced the development of generally accepted standards, requiring the FCC Laboratory to develop policies on procedures in the KDB to reliably determine the compliance of new and increasingly complex devices where accepted standards may not provide sufficient detail, and where Supplement C also does not provide sufficient detail. As standards organizations ultimately deliberate new procedures, we give due consideration to modifying and consolidating our recommended procedures in the KDB to reflect the state of standards development. We see no alternative to using the KDB or similar online Commission-controlled mechanism as an informative aid to communicate our policies on evaluation procedures to rapidly approve new devices while fulfilling our responsibility to transparently assure compliance with our exposure limits. In the competitive proprietary device market the first public information on a device often comes from our approval process. Because of this, manufacturers proposing to use a new technology often submit applications for approval late in their process and request expedited approval in an attempt to be significantly first to market and ahead of the competition. The use of the KDB as a reflection of our policies has thus evolved to meet the industry need for rapid approval of non-standard technologies which is clearly a significant, if not an easily quantifiable, benefit to early adopters of a new technology in a competitive industry. Moreover, the KDB provides benefits to parties seeking equipment authorizations, by providing information on the Commission's RF safety policies regarding new devices more quickly than technical standards bodies can develop independent procedures for those devices. Clearly, there are also costs associated with the ongoing uncertainty and the process of maintaining current awareness of such a rapidly changing and complex online resource as the KDB. However, these costs are outweighed by the significant benefits of the KDB as a more responsive means of guidance on evaluation procedures for new technology than can be offered by Supplement C.

41. We are also adopting our proposal to modify the language of section 2.1093(d)(3) to require that adequate documentation be provided in all cases relying on computational modeling. This is not redundant, as argued by Motorola,⁷² since the change from an "upon request" regime would alter the timing of the submission and relieve the Commission of having to engage in an *ad hoc* process of issuing information requests for this type of material. Since our evaluation of the appropriateness of computational modeling techniques and protocols that an applicant uses to demonstrate compliance with the SAR limits will typically necessitate our review of the documentation supporting these techniques and protocols, the most efficient approach for conducting this evaluation is to require the applicant to submit such documentation upfront, as a matter of course, in all cases where computational modeling is used.

⁷² See Motorola comments at 11-12.

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3. Pinna (Outer Ear) Classification as an Extremity

42. *Summary.* Currently, the outer ear, or “pinna,” is not included on the list of exceptions from the localized SAR limits for “extremities” in the Commission’s rules.⁷³ Nor has the Commission treated the pinna as subject to the localized SAR limits applicable to the head; nor has it required parties seeking equipment authorizations to measure or calculate localized SAR in the pinna.⁷⁴ This is because there is no standard for SAR measurement in the pinna. IEEE Std 1528-2003 describes the measurement procedure to be used for SAR measurement in the human head from cell phones. It states in pertinent part that, “[t]he measurement of SAR induced in the external tissues of the head, *e.g.*, the external ear (pinna), is not addressed in this standard.”⁷⁵ It states further that, “[t]his recommended practice does not address the measurement of SAR induced in the external tissues of the head, *e.g.*, the external ear (pinna).”⁷⁶ However, as explained further below, the IEEE subsequently initiated deliberations to consider classifying the pinna as an extremity.

43. Accordingly, in the *Notice*, we requested comment on classifying the pinna (outer ear) as an extremity, to which less stringent exposure criteria would apply. While we received comments both for and against this classification, we amend section 1.1310 of our rules to subject the pinna to the same RF exposure limit currently applicable to hands, wrists, feet, and ankles.⁷⁷

44. *Background.* Our localized SAR limit for the general population is 1.6 W/kg as averaged over any one gram cube of tissue, except for extremities, explicitly defined in our existing rules as the hands, wrists, feet, and ankles, where the limit is 4 W/kg as averaged over any ten gram cube of tissue.⁷⁸ (For occupational exposure, the localized SAR limit is 8 W/kg as averaged over any one gram cube of tissue, except for within the extremities where it is limited to 20 W/kg as averaged over any ten gram cube of tissue.) In the *Notice*,⁷⁹ we referred to deliberations by the IEEE of a standard revision that would treat the pinna of the human ear also as an extremity for the purpose of SAR evaluation.⁸⁰ We invited comment on whether we should consider adopting such a revision once approved by the IEEE. In the meantime, IEEE revisions characterizing the pinna as an extremity have been issued in IEEE Standards C95.1b-2004 and C95.1-2005. We note that classification of the pinna is only relevant to evaluation of localized SAR and not MPE. The MPE limits were derived under the assumption of whole body exposure, and control of localized SAR is implicit in their derivation.

45. *Comments.* Ericsson and Motorola both supported those revisions, and Motorola recommended that the Commission adopt it by reference in a separate rulemaking. Additionally, the

⁷³ Section 2.1093(d)(2) of the Commission’s rules.

⁷⁴ See <http://transition.fcc.gov/oet/ea/eameasurements.html> (visited on Oct. 2, 2012) (Commission web page including IEEE Std 1528-2003 in list of documents providing guidance to equipment authorization applicants).

⁷⁵ “IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head From Wireless Communications Devices: Measurement Techniques” at *Abstract*.

⁷⁶ *Id.* at *Introduction*.

⁷⁷ See § 1.1310 in Appendix B *infra*.

⁷⁸ See 47 CFR § 2.1093(d)(2).

⁷⁹ See *Notice* at para. 35.

⁸⁰ This revision has now been adopted by the IEEE as Amendment 2 to IEEE Std. C95.1 (IEEE Std. C95.1b-2004). The pinna is the external part of the ear that extends away from the skull, consisting primarily of cartilage.

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FDA⁸¹ commented that the resulting “increase in allowable power deposition [due to treating the pinna as an extremity] will not be significant enough to cause concern.”⁸²

46. However, the EMR Network stated that consideration of relaxing the SAR standard for the pinna raises the general issue of exposure limits, and it went on to suggest that the research on which the Commission exposure limits are based is outdated.⁸³ It attached abstracts and summaries of research supporting its contention that “non-thermal” biological effects are plentiful and raised the question of whether these effects imply harm to humans.⁸⁴ Additionally, the EMR Network summarized research showing skin temperature increases in the pinna while using a cell phone.⁸⁵ Further, it referred to a July 2003 letter from the federal Radiofrequency Interagency Work Group (RFAIWG Letter) to the IEEE, in which the RFAIWG stated that the IEEE should present a clear rationale for treating the pinna as an extremity.⁸⁶ In that letter, the RFAIWG stated that this rationale should include the biological properties of the pinna that qualify it to be treated as an extremity and recommends that, if thermal effects are to be the basis of the IEEE standard, the thermophysiology of the pinna and adjacent tissues should be discussed for all body sizes exposed.⁸⁷

47. *Decision.* We conclude that classification of the pinna as an extremity is supported by the expert determinations of the FDA and of the IEEE, will have no practical impact on the amount of human exposure to RF radiation, and is therefore appropriate. The FDA in particular has statutory responsibility to carry out a program designed to protect public health and safety from electronic product radiation and we therefore place heavy reliance on its public health and safety determinations.⁸⁸

48. As a standard-setting body that thoroughly reviewed the relevant research, the IEEE has made a similar determination based upon its technical expertise in the measurement of human exposure to RF radiation. Its rationale for adopting the extremity classification as a standard revision was that the tissue composition of the pinna is similar to that of the other extremities, and that the thermal tolerance of skin and cartilage, two types of tissue which comprise a majority of the tissue in the pinna, are well above that of the brain.⁸⁹ In particular, IEEE asserts that during device use “an increase in pinna temperature is principally due to thermal conduction from the device, not from RF absorption,” and that this temperature effect varies significantly between device models. According to IEEE, an increase in the pinna surface temperature may occur if convective cooling by air is impeded due to the pinna being pressed against the

⁸¹ Food and Drug Administration, Center for Devices and Radiological Health (FDA).

⁸² See FDA Comments at 1.

⁸³ EMR Network comments at 3-4.

⁸⁴ EMR Network reply comments at 1-2. Since we would consider discussion of “non-thermal” biological effects to be outside of the scope of ET Docket 03-137 which explicitly excluded discussion of the exposure limits themselves, we encourage EMR Network to file these and other comments related to the broader issue of the adequacy of our exposure limits in response to the new docket we are opening in the *Inquiry infra* at ¶¶ 205-252.

⁸⁵ *Id.* at 2, 7.

⁸⁶ *Id.* at 1. This letter, from Norbert N. Hankin to C-K. Chou, dated July 16, 2003, is reproduced in the EMR Policy Institute comments at 18.

⁸⁷ RFAIWG Letter at 1.

⁸⁸ 21 USC §§ 360hh-360ss, including the authority to take action, such as requiring manufacturers to recall or replace mobile phones shown to emit RF energy at a level that is hazardous.

⁸⁹ See IEEE Std C95.1-2005, *IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*, section C.2.2.2.3, *Rationale for applying the peak spatial-average SAR values for the extremities to the pinna.*

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head, but for longer use “convective heat transfer by the blood will stabilize pinna temperature.” IEEE reports that the surface of the pinna is normally cooler than average skin surface temperature under thermoneutral conditions, but “[e]ven in hot environments or after exercise, an additional increase of 1–2°C from use of a mobile phone would result in pinna temperatures that are well below the level at which cellular injury or pain will occur.”

49. We find that the IEEE’s expert consideration of recent research has alleviated the concerns raised about the pinna by the EMR Network and the RFIAGW.⁹⁰ Accordingly, we see no basis to subject the pinna to a different RF exposure limit than is applicable to the extremities and will modify our rules to specifically classify the pinna as an extremity.⁹¹ We note that this specification has no practical effect on human exposure. Standard evaluation procedures have not measured or calculated RF exposure in the pinna, but instead have measured RF exposure within the mannequin head, with the molded pinna of the mannequin acting effectively as a spacer that separates the phone from the head. However, based on numerical computations performed by the IEEE, we conclude that devices that meet the localized SAR limits applicable to the head will typically meet the SAR limit for extremities with respect to the pinna.⁹² The same devices that were approved before will continue to be approved, and the same devices that could not receive approval before this specification will not receive approval after this specification.

50. This action falls within the scope of this proceeding because the Commission in the *Notice*⁹³ invited comment on what consideration it might give to a change in the IEEE’s Standard Revision that would treat the pinna as an extremity. Our inclusion of the pinnae with the ankles, wrists, feet, and hands for purposes of RF exposure compliance is properly guided by our consideration of recommendations by federal agencies or organizations with expertise in measuring RF exposure and evaluating its environmental effects, including safety and human health.⁹⁴ We are mindful of the broader issues raised by the EMR Network and we will continue to work closely with the RFIAGW in supporting the evaluations and recommendations of the federal health and safety agencies on these important topics.

⁹⁰ See IEEE Std C95.1b-2004, *IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, Amendment 2: Specific Absorption Rate (SAR) Limits for the Pinna*.

⁹¹ We note that this specification has no practical effect on human exposure, as standard evaluation procedures have measured within the mannequin head, with the molded pinna of the mannequin acting effectively as a spacer separating the phone from the head. The safety of or the effect on the pinna itself does not seem to be contested by commenters. We note that EMR’s objection to the extremity classification is not based on the properties of or effect on the pinna, but rather is based on an interest in the consequent or secondary effect of reducing SAR within the head below what is currently consistent with our SAR guidelines, based on its concern over the propriety of our fundamental SAR guidelines. We also note that this last concern was explicitly excluded from this rulemaking, but is the subject of the *Inquiry, infra*, in which venue EMR Network’s position can be presented and considered.

⁹² See Beard, B., et al., *Comparisons of Computed Mobile Phone Induced SAR in the SAM Phantom to That in Anatomically Correct Models of the Human Head*, IEEE Trans. on Electromagnetic Compatibility, Vol. 48, No. 2, May 2006. The list of co-authors in this technical paper includes staff members from the FDA.

⁹³ See *Notice* at para. 35.

⁹⁴ See *EMR Network v. Federal Communications Commission*, 391 F.3d at 273, citing *Cellular Taskforce*, 205 F.3d at 90 (finding that the Commission did not abdicate its responsibilities under NEPA, or act in an arbitrary and capricious manner, in refusing to undertake a rulemaking to reassess its RF exposure limits based on new evidence but had properly credited outside experts, including IEEE and federal agencies composed of experts in this area; and that the Commission’s decision to maintain the status quo when the Environmental Protection Agency (and other agencies) saw no reason to jump in represents the sort of agency priority setting that the courts are not inclined to second-guess).

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In this regard, the broader issue of the adequacy of our exposure limits will be raised in a separate *Inquiry* as previously discussed.⁹⁵

4. Part 1 / Part 95 MedRadio (formerly Medical Implant Communications Service) Measurement Consistency

51. *Summary.* Section 1.1307(b)(2) requires initial SAR evaluation for medical devices within the Medical Device Radiocommunication Service (MedRadio Service) by either computation or measurement, but, for MedRadio medical implant transmitters, section 95.1221 allows only computation for initial evaluation of these devices. Our amendment to section 95.1221 herein corrects this inconsistency to allow either computation or measurement in both sections.

52. *Original Proposals.* The MedRadio Service currently permits the transmission of non-voice data for the purpose of facilitating diagnostic and/or therapeutic functions involving both implanted and body-worn medical devices.⁹⁶ MedRadio was formerly known as the Medical Implant Communications Service (MICS) and did not include body-worn transmitters in its original definition. In the *Notice*, we pointed out an inconsistency in our rules regarding requirements for implanted transmitters to comply with Commission guidelines on RF exposure.⁹⁷ At the time of the *Notice*, section 95.603(f) of the Commission's rules required that applications for equipment authorization of devices operating under this section include a report showing the results of computational modeling of patient exposure using finite difference time domain (FDTD) techniques.⁹⁸ This rule further stated that the Commission may also request the submission of measurement data for specific absorption rate (SAR). On the other hand, with the introduction of body-worn transmitters in the MedRadio service, section 1.1307(b)(2) of the rules continues to specify that compliance of the new MedRadio Service transmitters with the SAR limits in section 2.1093 may be demonstrated by *either* FDTD analysis or submission of SAR measurement data, with the Commission retaining the option of also requesting measurement data to support an FDTD analysis, if appropriate. We proposed that the latter, flexible rule is more appropriate, providing an applicant the option of demonstrating compliance either by use of computational techniques or by a laboratory measurement study. We therefore proposed to revise section 95.603(f) to make it consistent with section 1.1307(b)(2). For completeness, we also proposed to add language to section 2.1093(d)(3) which addresses compliance of portable devices including those in the MedRadio Service. Since proposing this revision, our rules regarding requirements for MedRadio Service transmitters have been

⁹⁵ See ¶¶ 5-7, 12, footnote 84 *supra*, and *Inquiry infra* at ¶¶ 205-252.

⁹⁶ 47 CFR § 95.1201 *et seq.* At the time of the *Notice*, this service was more limited in scope and was referred to as the Medical Implant Communications Service (MICS). However, a recent rulemaking expanded MICS into the MedRadio Service and permitted the operation of body-worn, as well as implanted medical devices, including those using either listen-before-talk (LBT) frequency monitoring or non-LBT spectrum access methods, in designated portions of the 401-406 MHz band. See *Report and Order*, ET Docket No. 03-92 (Biotronik, Inc., Request for Waiver of the Frequency Monitoring Requirements of the Medical Implant Communications Service Rules); ET Docket No. 05-213 (DexCom, Inc., Request for Waiver of the Frequency Monitoring Requirements of the Medical Implant Communications Service Rules); RM-11271 (Amendment of Parts 2 and 95 of the Commission's Rules to Establish the Medical Device Radiocommunication Service at 401-402 and 405-406 MHz); and ET Docket No. 06-135 (Investigation of the Spectrum Requirements for Advanced Medical Technologies), FCC 09-23, released March 20, 2009.

⁹⁷ See *Notice* at para. 48.

⁹⁸ Finite difference time domain (FDTD) analysis is a method for calculating RF electric and magnetic fields inside materials by stepping through time at a grid of spatial points in a computer simulation. FDTD is used in this context to determine the SAR, which is simply related to the electric field in simulated tissue.

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relocated to Subpart I of Part 95, and the content of section 95.603(f) is now located in section 95.1221, entitled “RF exposure.”⁹⁹

53. *Comments.* Only two commenters addressed this issue, and both were critical of FDTD analysis.¹⁰⁰ The FDA states that it is not sufficient to specify only that manufacturers of MedRadio Service implants report the results of computational modeling of patient exposure using FDTD techniques. The FDA says that FDTD simulations may lead to significant uncertainty and/or errors if inappropriate parameters and models are used. It recommends that additional guidelines and specifications be supplied if FDTD is to be an option for demonstrating compliance. FDA states that computational modeling for MedRadio Service implants must specifically address the electrical behavior of the transmitter very close to the body. It urges the Commission to identify scientific papers showing that compliance can be demonstrated using computational modeling. It asserts that FDA experts have reviewed submissions to the Commission from medical device manufacturers using computational modeling, and they have found technical irregularities in these submissions.

54. The IT’IS Foundation¹⁰¹ asserts that an FDTD analysis can be reliable, but only if the device is being simulated correctly.¹⁰² Otherwise, IT’IS claims, there is no way to determine the accuracy of the analysis. According to IT’IS, studies have shown that FDTD results can be “grossly off” if the persons performing the analysis are inexperienced. IT’IS states that, according to its experience, measurements are much more reliable indicators of compliance than computations, and it strongly recommends that the Commission require measurements for evaluating compliance for MedRadio Service implants. IT’IS also cautions that very localized temperature increases in tissue can in theory be substantial (several degrees) near implanted conductors, even when the 1-g average SAR limits are not exceeded.

55. *Decision.* The goal of our original proposal was to correct an inconsistency in the rules with respect to this issue, and our final rules clarify this intent. The inconsistency originated with the promulgation of section 95.603(f) and was perpetuated when the Commission relocated that section to another location in Part 95, renumbering it as section 95.1221, as a result of the establishment of the new MedRadio Service.¹⁰³ We did not, however, intend to alter the approach we established when we first codified section 1.1307(b)(2), which permits an applicant for authorization of a MedRadio device – either body-worn or designed for implant – to demonstrate compliance with RF exposure requirements either through computational modeling or laboratory measurement techniques, subject to the Commission’s discretion to require the submission of measurement data where the applicant based its showing on computational modeling.¹⁰⁴ Additionally, we intend to provide guidelines in the future for using computational modeling to demonstrate compliance in a future OET Laboratory Division Knowledge Database (KDB) document.¹⁰⁵ This approach should alleviate concerns expressed by the FDA and IT’IS regarding potential analysis inaccuracies and irregularities. Thus, we herein replace the current language of section 95.1221 with a paragraph similar to that which we had proposed for section 95.603(f) in the *Notice*.¹⁰⁶ Moreover, herein, below in the *Further Notice*, we propose more specific requirements to

⁹⁹ *Amendment of Parts 2 and 95 of the Commission’s Rules to Establish the Medical Device Radiocommunication Service at 401-402 and 405-406 MHz*, RM-11271, *Report and Order (MedRadio Order)*, 24 FCC Rcd 3493 (paras. 66-68), 3509 (2009); *see also* 47 CFR § 95.1221.

¹⁰⁰ *See* FDA comments at 1-2, IT’IS Foundation comments at 3.

¹⁰¹ IT’IS Foundation, Dr. Niels Kuster (IT’IS).

¹⁰² *See* IT’IS Foundation comments at 3.

¹⁰³ *See MedRadio Order*, footnote 99 *supra*.

¹⁰⁴ *See* 47 CFR § 1.1307(b)(2).

¹⁰⁵ *See* para. 28 *supra*.

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ensure that any software models used to compute SAR give sufficiently accurate results to confirm compliance.¹⁰⁷

56. In summary, the rule revisions we adopt here eliminate an inconsistency in the rules. The benefits of these revisions include clarifying the rules, thereby reducing confusion among regulated parties. There should be no cost associated with these rule changes, and thus benefits of these changes outweigh their costs.

B. Mitigation

57. Mitigation matters are post-evaluation procedures to ensure exposure limits are not exceeded, such as labels, signs, barriers, enforcement, and occupational issues. We include in this section clarifications related to the application of occupational exposure limits for devices and at fixed transmitter sites. A summary of significant comments and discussion on topics initiated by the *Notice* but that do not necessitate changes to our rules are provided in Appendix H. Specifically pertaining to mitigation, Appendix H discusses the topic of local zoning concerns.

1. Labeling and Instructions for Mobile and Portable Devices Intended for Occupational Use Only

58. *Summary.* In the *Notice*, we proposed more specific labeling and instructional requirements for devices intended to be operated only in an occupational setting. Comments received were generally supportive, and we adopt our proposed changes in sections 2.1091(d)(3) and 2.1093(d)(1) of our rules.

59. *Original Proposals.* With respect to portable and mobile devices intended for occupational use only, we proposed to modify our rules to specify that product/equipment labels may be used to satisfy the requirements for making workers aware of the potential for exposure from such portable and mobile devices, consistent with labeling guidelines developed by the Telecommunications Industry Association (TIA). We proposed that such labels must indicate that a device is for occupational use only, refer the user to specific instructional information on RF exposure (*e.g.*, in a user manual), and note that the label and its referenced information are required for RF exposure compliance. We also proposed to require that the label be legible and clearly visible to a user. We further proposed to require that the instructional material provide the user with information on how to use the device in such a way as to ensure compliance with the applicable occupational/controlled limit, *e.g.*, instructions as to proper device position, duty factor requirements, proper use of accessories, *etc.* We proposed that a sample of the label, illustrating its location on the device, and the accompanying instructional material, be filed with the Commission along with the application for equipment authorization.

60. *Comments.* Commenters that addressed our proposals for labeling requirements for mobile and portable devices for occupational use generally supported them.¹⁰⁸ TIA elaborated on the guidance included in its TSB-133¹⁰⁹ that was referenced in the *Notice*¹¹⁰ and provides guidelines on advisory labeling and information for inclusion in user manuals. Motorola supported the proposals for labeling and noted that the labeling provisions in TSB-133 were being used by leading manufacturers for mobile devices at the time Motorola filed its comments. TIA pointed out that the scope of the

(Continued from previous page) —————

¹⁰⁶ See section 95.603(f) in Appendix A of the *Notice*.

¹⁰⁷ See para. 168 *infra*.

¹⁰⁸ See Cisco comments at 14; Motorola comments at 12-14; TIA comments at 11-12.

¹⁰⁹ Telecommunications Industry Association, Telecommunications Systems Bulletin, TSB-133, June 2003.

¹¹⁰ See *Notice* at para. 40.

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information outlined in TSB-133 is aimed at providing “adequate” written and/or verbal information to the end user and believed that the content of the label specified in TSB-133 should be sufficient for complying with the Commission’s requirements. TIA urged the Commission to specifically state that a manufacturer’s responsibility to make a user “fully aware” is limited to providing the information outlined in TSB-133 in an appropriate user manual or instruction booklet and that the ultimate responsibility to provide this information to the end user rests solely with the employer. On the other hand, Dr. Dina Simunic suggested that holders of grants for mobile and portable devices used in occupational settings should be required by the Commission to coordinate with end users to ensure that they provide appropriate RF safety training.¹¹¹

61. TIA proposed that the Commission’s rules provide that a “screen flash” upon power up, containing the same contents as the TSB-133 label, will also satisfy the Commission’s requirements.¹¹² When a label is used, TIA continued, the Commission’s rules should require that it be in an easily viewable location. TIA argued that label placement in battery compartments is appropriate, in particular for maintaining label integrity and legibility.

62. *Decision.* We are adopting labeling requirements related to occupational/controlled exposure from mobile and portable devices, consistent with our proposals and the comments we received, by modifying sections 2.1091(d)(3) and 2.1093(d)(1) to provide that labels may be used to satisfy the requirements for making workers aware of the potential for exposure under the conditions proposed in the *Notice*. In addition, we will update OET Laboratory Division publications as necessary to provide more detailed guidance on complying with the requirements for labeling devices intended for occupational use. While we appreciate the argument by TIA that placement in the battery compartment helps ensure integrity and legibility of a label, we do not consider that such placement is clearly visible to the user. However, we agree with TIA’s concept of a “screen flash” option on power up as a more practical solution than external labeling and refer in general to either labels or a screen flash as “visual advisories” required in the final rules.¹¹³ On the other hand, we do not specify a format for visual advisories at this time as suggested by TIA but rather encourage development of labeling standards that parallel our signage proposals in the *Further Notice* using similar symbols, colors, and signal words.¹¹⁴ With respect to requirements for coordination between equipment manufacturers and end users on training, we are adopting language that coordination with end-user organizations is encouraged but not required. However, as discussed in the next section, training is required for persons subject to exposure in excess of our general population exposure limits.

63. Workers must be made aware of the steps necessary to protect against exposure to RF energy to avoid exceeding our occupational limits. By clarifying the content of labels which we already require and allowing further flexibility through screen flash, as suggested by comments, we conclude that the measures we are adopting are the most cost-effective way to reliably achieve awareness.

2. Clarification of Application of Occupational Exposure Limits

64. *Summary.* Our occupation/controlled limits apply in part when individuals are “fully aware” of and can “exercise control” over their exposure. We proposed to state in our rules that appropriate information and training is necessary to achieve full awareness and control of exposure and we herein adopt these proposals with minor modification based on the comments received. We are also adding language to

¹¹¹ See Dr. Dina Simunic comments at 4.

¹¹² See TIA comments at 11-12.

¹¹³ If the potential RF exposure generated by the device exceeds the occupational exposure limits such that it is necessary to warn that the device not be used or even turned on without first taking advance protective measures, we here prohibit the use of the “screen flash” option. See Appendix A.

¹¹⁴ See para. 190 *infra*.

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remind licensees of their obligation to consider worker as well as public exposure. Finally, we codify in our rules the extent to which occupational/controlled limits apply to amateur radio licensees.

65. *Original Proposals.* The occupational/controlled exposure limits in our rules apply “in situations in which persons are exposed as a consequence of their employment provided those persons are *fully aware* of the potential for exposure and can *exercise control* over their exposure.”¹¹⁵ The limits for occupational/controlled exposure also apply “in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.”¹¹⁶ (The general population/uncontrolled exposure limits apply “in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.”)¹¹⁷

66. The meaning of key terms used in the definition of the application of occupational exposure may be subject to interpretation. We proposed to clarify in our rules that being “fully aware” means that an exposed person has received written and verbal information concerning the potential for RF exposure and has received training regarding appropriate work practices relating to controlling or mitigating his or her exposure. We proposed to specify that to “exercise control” means that an exposed person is able to reduce or avoid exposure by administrative or engineering controls. Examples of such controls would include providing workers with RF safety training, use of personal RF monitors by workers, use of RF protective suits, placing of appropriate physical restrictions on areas where high RF fields exist, and limiting time of exposure or proximity to the RF source. As specified in our existing rules, transient individuals must simply be made aware of their potential exposure.¹¹⁸ We proposed in the *Notice* that this awareness could be achieved by means of written and/or verbal information, including, for instance, appropriate signage.¹¹⁹

67. We also noted that some licensees have not always properly considered their responsibilities to ensure compliance for workers at their site when evaluating exposure of the general public. We accordingly proposed to add language to section 1.1310 of our rules to remind licensees and applicants of their obligation to consider exposure of workers near RF sources as well as exposure of the public.¹²⁰

68. *Comments.* Most commenters supported providing further guidance on when occupational/controlled exposure limits apply; however, they expressed a variety of opinions as to the details of our requirements. Cingular Wireless LLC (Cingular) supported the proposals and stated that they reflect existing standard industry practice.¹²¹ TIA supported our proposals to assure workers are properly informed about exposure at antenna sites and refers to its Telecommunications Systems Bulletin 92 (TSB-92) that addresses the need for licensees to implement RF safety programs for fixed station equipment/antenna sites.¹²² Many of the comments were only peripherally related to the proposals made in the *Notice*.

69. The interpretation of what it means to be “fully aware” of the potential for occupational RF exposure generated the most comment and concern. Some commenters supported the proposed note

¹¹⁵ See 47 CFR § 1.1310 Table 1 Note 1; emphasis added in italics.

¹¹⁶ *Id.*

¹¹⁷ See 47 CFR § 1.1310 Table 1 Note 2.

¹¹⁸ *Id.*

¹¹⁹ See *Notice* at para. 38.

¹²⁰ See *Notice* at para. 39.

¹²¹ See Cingular comments at 15.

¹²² See TIA comments at 11-12.

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to section 1.1310 more or less as written,¹²³ but others objected to this proposal or requested further clarification regarding how this requirement can be satisfied. For example, several commenters did not agree that both written and verbal information should be required in order to make persons fully aware of the potential for exposure.¹²⁴ CTIA noted that training concerning RF exposure and controlling or mitigating exposure is often part of an integrated program, and it recommended that the Commission allow either written *or* verbal information relating to exposure and safe work practices. Sprint maintained that there is no rationale for requiring licensees to provide both written and verbal information. Motorola argued that the Commission should not require that employers provide three “layers” of information, *i.e.*, written information, verbal information, and comprehensive training, when a single “performance based” requirement for training should be sufficient. Motorola suggested that the note to section 1.1310 should indicate that a number of information and training resources are available or under development, and the Commission should allow a licensee or site manager the flexibility to select the option most suitable for a given antenna site and work force.

70. Broadcast Signal Lab, LLP (BSL) said that different situations warrant different procedures and suggested requiring written “*and/or*” verbal information.¹²⁵ For example, some situations may require only signage, while others may require personal instruction. BSL recommended that the Commission rely on the reasonable judgment of the licensees in the context of each particular situation as to how to provide the relevant information. BSL advised its clients that they maintain a written “access and control of RFE” policy so that it can be readily communicated to employees and outside contractors. It suggested that the Commission might want to consider adding to its rules a requirement that each licensee have such a policy on file and share it with workers on a regular basis, as appropriate.

71. The National Association of Broadcasters (NAB) noted that, as a practical matter, studios and transmitters might be located in the same facility where non-technical personnel may work.¹²⁶ NAB was concerned that these non-technical employees “may not be currently apprised with both written *and* verbal information about occupational exposure” when common practice is for licensees to post advisory signs in transmitter areas of such a facility where the general population exposure limits might be exceeded. These areas would generally be off-limits to non-technical employees. However, these employees might occasionally transit through such areas. If both written and verbal information is necessary, NAB wanted to know specifically what information must be provided to these employees. Similarly, AT&T Corporation (AT&T) asked what constitutes appropriate verbal information.¹²⁷

72. With respect to “transient” individuals, Pinnacle, Southern,¹²⁸ and Hammett and Edison suggested that RF warning/alerting signage is probably the most effective means to provide RF safety information.¹²⁹ They also agreed that in some cases there is indiscriminate posting of signs (*i.e.*, inappropriate quantity and/or type), while in other cases not enough basic instructions are given on the sign to ensure compliance. Pinnacle encouraged the Commission to remind licensees to provide specific safety guidelines and information on RF warning/alerting signs, especially those on rooftops. It also urged the Commission to consider establishing unambiguous guidelines for when RF signs would be

¹²³ See Cingular comments at 15; Cisco comments at 14; Fry comments at 1; EMR Network comments at 4; Global comments at 1-2.

¹²⁴ See BSL comments at 16; CTIA comments at 12-13; Motorola comments at 12-14; Pinnacle comments at 5-7; Southern reply comments at 6-8; Sprint comments at 2-3.

¹²⁵ See BSL comments at 16.

¹²⁶ See NAB comments at 2-3.

¹²⁷ See AT&T comments at 1.

¹²⁸ Southern Communications Services, Inc. & Southern Company Services, Inc. (Southern).

¹²⁹ See Pinnacle comments at 5-7; Southern reply comments at 6-8; Hammett and Edison comments at 1-2.

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required for different antenna sites. RSI Educational Foundation (RSI) also stated that there is a need for proper assessment of signage, and it asked the Commission to consider requiring more specific and comprehensive programs for dealing with RF levels above the general population limits.¹³⁰ RF People also asked that the Commission provide more detailed guidance on what is needed, especially at rooftop locations.¹³¹ Global RF Solutions (Global) claimed that its investigations at “several hundred” existing communications sites indicated that personnel were never given written or verbal instructions concerning RF safety.¹³² Global also noted that signage for warning personnel is seldom posted in a correct manner at most of the sites it has visited.

73. Southern stated that providing too much specificity could create standards that do not account for the variable nature of different facilities and the character and size of a licensee’s workforce.¹³³ Southern agreed with Motorola that the Commission’s rules should set a single “performance based” requirement for training and that licensees should have the flexibility to use the type of training best suited to their operations and workforce. Southern stated that there is no evidence that worker training has been a major problem that would warrant the Commission providing detailed and specific requirements. Southern maintained that other agencies, such as the Occupational Safety and Health Administration (OSHA), are a better source for such information.

74. Hammett and Edison were concerned that there may be uncertainty or excessive burden associated with any requirement to provide RF training to “third party” workers not under the control of a licensee. Hammett and Edison argued that it is impractical for Commission licensees to have advance notice of worker access when a licensee is one of many tenants at a site. It maintained that OSHA already has established procedures for adequate notice and/or training in occupational settings, and it recommended that the Commission not duplicate or overlap OSHA’s regulatory jurisdiction.

75. *Decision.* The fundamental purpose of our rules regarding occupational/controlled exposure is to require that workers at the higher permitted levels of exposure have the appropriate level of awareness and control to ensure that they are not exposed above the occupational/controlled limits. We agree with commenters that argue that flexibility is needed with respect to how such information is provided to adapt to the needs of various sites and circumstances.¹³⁴ Therefore, we are specifying that for individuals exposed as a consequence of their employment, using the occupational/controlled limits, written *and/or* verbal (orally-communicated) information must be provided, at the discretion of the responsible party as is necessary to ensure compliance with the occupational/controlled limits. In addition, with the exception of transient individuals, appropriate training regarding work practices that will ensure that exposed persons are “fully aware of the potential for exposure and can exercise control over their exposure” is required to be provided. We conclude that this two-tiered approach will provide sufficient information to ensure that people are adequately protected.

76. Regarding specific guidelines on what kind of information is required and what constitutes adequate training, we intend to rely primarily on instructional and training resources already available. Section 1.1310 of our rules already references OET Bulletin 65 as one resource, and we plan to update this bulletin after the conclusion of this docket to provide additional information regarding RF safety programs and available resources, including information now incorporated in the IEEE C95.7 recommended practice for RF safety programs referenced in the *Notice*. We agree with the requests of several commenters that we propose more specific guidelines; thus we are proposing specific rules

¹³⁰ See RSI comments at 1-2.

¹³¹ See RF People comments at 1-3.

¹³² See Global comments at 1-2.

¹³³ See Southern reply comments at 6-8.

¹³⁴ See para. 69 *supra*.

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elaborating upon written and/or verbal information, appropriate training, and signage and barrier requirements in the *Further Notice*, including consideration of third-party workers. We note that training is not required for transient individuals, but they must receive written and/or verbal information and notification (for example, using signs) concerning their exposure potential and appropriate means available to mitigate their exposure. We further note that the designation of “transient individual” applies to visitors and people traversing the site, not to third-party workers performing maintenance on the site for an extended period. However, in the event of complaints that result in enforcement investigations, we will evaluate, on a case-by-case basis, whether the information requirements are met, and if not whether the general population/uncontrolled exposure limits are appropriate to apply in a specific area where transient access is permitted.

77. It should be helpful to licensees to codify our earlier adopted policy with regard the use of occupational/controlled limits at amateur radio stations. This policy was established in the RF Report and Order of 1996,¹³⁵ but was not incorporated in the rules at that time. It allows amateur stations to be evaluated with respect to occupational/controlled exposure limits as long as appropriate training and information has been provided to the amateur licensee and members of his or her immediate household. We here codify this policy by adding a paragraph to new sub section 1.1310.¹³⁶

78. We adopt our proposal at section 1.1310(e)(3) as shown in Appendix A to require licensees and applicants to properly consider their responsibilities to ensure compliance for workers as well as the public at their site. We disagree with comments that we should defer to OSHA with regard to RF safety issues. First, OSHA 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. Second, although we do collaborate with OSHA staff regarding matters related to RF safety, and both agencies are members of an inter-agency RF working group,¹³⁷ we are not aware that OSHA has adequate resources to ensure compliance with our limits for occupational/controlled exposure among our licensees and grantees.

79. Costs of these new rules adopted herein should be minimal since, with the exception of transient personnel, workers in controlled environments near fixed transmitter sites have been required to be fully aware of their potential for exposure,¹³⁸ and we expect that they accordingly should have already been receiving some degree of RF safety training. In addition to the obvious benefit to the public and workers of requiring application of controls intended to avoid excess exposure, another anticipated benefit of these actions in this *Order* is a reduction of uncertainty as to what is necessary to establish compliance near RF transmitters. By this *Order*, transient individuals are not required to be trained, so the associated training cost are negligible, with the exception that these individuals must receive written and/or verbal information and notification (for example, using signs); however we propose in the *Further Notice* extensions of these adopted rules, and we seek comment on their associated costs and benefits. For example, transient individuals would be required to be supervised by trained personnel.¹³⁹ In the *Further Notice* we generally propose to extend requirements to include aspects of RF safety programs that have been developed in coordination with industry in the intervening years since the *Notice* with the goal of ensuring compliance and the safety of workers, particularly near high power transmitting antennas, in the most efficient, flexible, and least burdensome manner possible.

¹³⁵ *Report and Order*, ET Docket 93-62, *Guidelines for Evaluating the Environmental Effects of Radio frequency Radiation*, 11 FCC Rcd 15123 (1996), para. 161.

¹³⁶ See § 1.1310(e)(4) in Appendix A *infra*.

¹³⁷ Radiofrequency Interagency Working Group (RFIAWG).

¹³⁸ See § 1.1310, Table 1, Note 1.

¹³⁹ See para. 184 *infra*.

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3. Responsibility for Compliance at Fixed Sites with Multiple Transmitters

80. *Summary.* Our rules do not address apportionment of responsibility among licensees that exceed 5% of the exposure limits and are not categorically excluded. Comments received suggested that it is necessary for an individual licensee to be assigned primary responsibility for compliance at a multiple use site. However, we clarify that this is not the case and emphasize cooperation and that failure to comply at multiple use sites can result in penalties for all site occupants that contribute significantly to exposure, not just the newest occupant or the occupant which contributes the most to exposure.

81. *Background.* The Commission's rules effectively place limits on the total exposure due to multiple fixed transmitters in any environment. A significant issue raised by several commenters involved difficulties encountered in determining compliance responsibility and cooperation at communications sites with multiple transmitters. Such multi-user sites probably constitute the majority of contemporary broadcast and fixed wireless base station installations. Our current rules assign responsibility for compliance to new and renewal applicants at such sites but do not provide guidance for cooperation of these applicants with existing tenants in the process of bringing non-compliant sites into compliance.¹⁴⁰ This subject was not raised in the *Notice*, and we are not changing our rules here with respect to this issue, but, we do provide herein some clarification of our rules in response to this issue.

82. *Comments.* BSL noted that the exclusion thresholds for routine evaluation of multiple transmitter sites are based on the emissions of individual antennas.¹⁴¹ However, BSL continued, section 1.1306(a) of the Commission's rules implementing the NEPA requires that environmental effects be evaluated on a cumulative, as well as an individual, basis, thus implying that the proposed thresholds for exclusion should be based on cumulative emissions when multiple transmitters are present.¹⁴² BSL suggested that there should be a threshold below which the operator of a transmitter can be assured that its facility will be in compliance with the Commission's RF guidelines regardless of what other emitters are present. BSL stated that using the "5%" rule in section 1.1307(b)(3) of the rules is useful in simplifying analysis of responsibility at multiple transmitter sites.¹⁴³ However, it proposed that we apply a "second tier" to Table 1 to indicate where there is a need for routine evaluation by individual contributors at multiple emitter sites.

83. T-Mobile maintained that the Commission's rules for dealing with multiple emitter sites are sometimes impractical or confusing.¹⁴⁴ T-Mobile noted that while the current rules require newcomers to a site to evaluate the RF environment and, if necessary, submit an Environmental Assessment (EA), they are not required to take primary responsibility to resolve any subsequent non-compliance, nor are they required to advise existing carriers at the site that the additional transmitter could create a non-compliant situation. T-Mobile and Southern urged the Commission to clarify that although existing licensees at multiple emitter sites must cooperate with a newcomer in resolving RF issues, the newcomer bears primary responsibility for ensuring compliance.¹⁴⁵ Such a policy would assign appropriate responsibility instead of the current situation where, according to Southern, no one in particular is responsible for ensuring ongoing compliance. Southern also recommended that the

¹⁴⁰ See 47 CFR §§ 1.1307(b)(3)(i) and (ii).

¹⁴¹ See BSL comments at 10-15.

¹⁴² See 47 CFR § 1.1306(a).

¹⁴³ The "5%" rule specifies that when multiple fixed transmitters are present in an accessible area, actions necessary to ensure compliance are the shared responsibility of all licensees whose transmitters produce power density levels that exceed 5% of the appropriate exposure limit at the area in question. 47 CFR § 1.1307(b)(3).

¹⁴⁴ See T-Mobile comments at 16-17; Southern reply comments at 8-10.

¹⁴⁵ See Southern reply comments at 8-10.

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Commission urge site owners, leasers, and managers to provide a mechanism by which lessees may be able to exchange relevant information regarding site compliance.

84. *Discussion.* The commenters suggest that our current rules do not address in all particulars the issue of licensee and applicant responsibility at multiple emitter sites, specifically, that our rules do not include an apportionment of responsibility among licensees that exceed 5% of the exposure limits and are not categorically excluded. While we clarify our present rules regarding responsibility by the discussion herein, we also include more information on the subject of joint RF safety programs and address mitigation in the *Further Notice infra*,¹⁴⁶ and intend to include further guidance in subsequent updates to OET Bulletin 65. Given the variety of situations presented by multiple transmitter sites, responsibility for compliance and preparation of Environmental Assessments continues to apply to multiple transmitter sites as described in section 1.1307(b)(3) of our rules, and “significant” transmitters can be assumed to be based on the same threshold of 5% defined there. We note that when routine evaluations are required at such sites, all relevant co-located licensees are responsible for compliance. Therefore, it is in the interest of these licensees to share information about power and other operating characteristics in order to achieve accurate representations of the RF environment. The Commission continues to encourage all site occupants, owners,¹⁴⁷ leasers, and managers to cooperate in these endeavors, and we note that site user agreements are particularly useful and desirable to achieve this end. As demonstrated in the record,¹⁴⁸ all licensees that exceed five percent of the RF exposure limit at any non-compliant location are jointly and severally responsible, and the Commission may impose forfeiture liability on all such licensees.¹⁴⁹ Regarding BSL’s comments on multiple transmitter sites, we seek comment on a proposal to sum exclusion thresholds due to multiple fixed RF sources in the *Further Notice infra*.¹⁵⁰ We also propose to eliminate the current Table 1 in the *Further Notice, infra*, and BSL can raise its comment regarding a separate threshold for individual contributors at multi-emitter sites if it deems it relevant in context of the proposed rule.¹⁵¹

4. Labeling and Installation of Fixed Consumer Transmitters

85. *Summary.* We originally proposed in the *Notice*¹⁵² to modify our rules dealing with labels placed on consumer subscriber transceiver antennas, which are required regardless of output power or exposure potential in specific rule parts as listed in Table 1 of section 1.1307(b) of our rules. We do not adopt our original proposals in this *Order* since we are proposing modifications to this rule in the *Further Notice* under a broader scope of mitigation issues dealing with labeling and signage. While we raised the issue of installation requirements of fixed subscriber transceiver antennas in the *Notice*, we did not make any specific proposals. We do not specify installation requirements for these antennas in our rules, and we make no change in this *Order*.

86. *Original Proposals.* The Commission currently requires labels for certain consumer products that use wireless technology to provide users with information on RF exposure. These labeling requirements apply to subscriber transceiver antennas in certain service categories. Licensees in these services are required to attach a label to subscriber transceiver antennas that: (1) provides adequate notice regarding potential radiofrequency safety hazards, *e.g.*, information on the safe minimum separation

¹⁴⁶ See para. 193 *infra*.

¹⁴⁷ See 47 CFR § 1.1307(b)(3), where “[o]wners of transmitter sites are expected to allow applicants and licensees to take reasonable steps to comply...”

¹⁴⁸ See, *e.g.*, *Radio One Licenses, et. al.*, 19 FCC Rcd 23922 (2004), *recon. denied*, 21 FCC Rcd 14271 (2006).

¹⁴⁹ See 47 U.S.C. § 312.

¹⁵⁰ See paras. 139-141 *infra*.

¹⁵¹ BSL - or any other party - should specify the particulars of any such proposal.

¹⁵² See section III. G. of the *Notice*.

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distance required between persons and transceiver antennas; and (2) references the applicable Commission-adopted limits for radiofrequency exposure specified in section 1.1310 of our rules. In the *Notice*, we asked for comment on whether there are conditions under which we could forgo labeling requirements.¹⁵³

87. We proposed to use criteria based on power and frequency to trigger labeling requirements and to apply the labeling requirements for fixed consumer devices equivalently across all service categories for which they currently apply. We also proposed a new labeling requirement for fixed consumer/subscriber transceivers in the 39 GHz services governed by Part 101, Subpart C, which operate similarly to other consumer devices affected by these rules. We further proposed to exclude devices from labeling requirements if the responsible party demonstrates by any appropriate means that MPE or SAR limits could not be exceeded regardless of proximity to the antenna.¹⁵⁴

88. We asked for comment on these proposals and on whether different criteria are appropriate for certain services or circumstances and whether there are other services to which these or other labeling requirements should apply. For example, should these or other labeling requirements apply to cellular, PCS, and other CMRS licensees that choose to offer consumer-based fixed services? We also requested comment on whether the term “subscriber” adequately encompasses the potential users of such transceiver antennas.¹⁵⁵

89. We discussed issues related to professional installation and other safety measures taken to ensure the safe operation of the subscriber antennas. We noted the desirability of having these antennas professionally installed, and we encouraged certain safeguards, such as the incorporation of safety “cut-off” devices to reduce or shut down power to an antenna when the transmitted beam is blocked by a person. We also noted that instructional materials should be provided to users and installers that advise as to safety precautions and minimum separation distances. We invited comment on these proposals in the *Notice*,¹⁵⁶ but we decide not to adopt these proposals in this *Order*.

90. *Comments.* Several commenters indicated that the use of labels to provide disclosure of possible RF exposure is reasonable or appropriate,¹⁵⁷ and no commenters addressing these issues explicitly objected to the use of labels. IEEE 802 and Wi-Fi expressed support for using certain power thresholds as a trigger for evaluation of low-power section 15.247 devices to determine when labeling would be required.¹⁵⁸ Some of the comments referred to portable or mobile consumer devices; however, labeling has not been required nor was it proposed in the *Notice* for these devices; this section deals only with fixed consumer transceiver antennas.¹⁵⁹

91. IEEE 802 also believed that providing samples of advisory labels and user manual informational disclosures with applications is appropriate.¹⁶⁰ PalmOne noted that the user manual is the proper place for detailed exposure information, and it said that some international regulatory bodies

¹⁵³ See *Notice* at para. 42.

¹⁵⁴ See *Notice* at para. 42.

¹⁵⁵ See *Notice* at para. 42.

¹⁵⁶ See *Notice* at para. 43.

¹⁵⁷ See EMR Network comments at 4; PalmOne comments at 5; IEEE 802 comments at 5-8; TIA comments at 11-12; Wi-Fi comments at 7.

¹⁵⁸ See IEEE 802 comments at 5-8; Wi-Fi comments at 7.

¹⁵⁹ See PalmOne comments at 5.

¹⁶⁰ See IEEE 802 comments at 5.

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already require that RF exposure information be included in a prominent location in user manuals for consumer products such as cellular telephones.¹⁶¹

92. Nokia noted that the labeling proposals apply only to specific service categories, and did not support extending labeling requirements to CMRS low-power transmitters.¹⁶² Cisco suggested that for consumer wireless devices such as home networks, garage door remotes, and other low power devices, RF safety information provided in user manuals is sufficient.¹⁶³ In addition, Cisco continued, a consumer is more likely to read safety information in a user manual than text on a small label. T-Mobile supported the proposal to not require labeling of subscriber transceiver antennas if the responsible party demonstrated compliance with MPE or SAR limits regardless of proximity to the antenna.¹⁶⁴ It concurred that labeling may be considered sufficient to ensure compliance if labels will effectively prevent exposure in areas near antennas where the limits may be exceeded.

93. Regarding installation requirements, Nokia commented that, for self-installed subscriber transceivers, clear instructions should be included in the user's manual stipulating that the antenna should be mounted so that no person can approach closer than the minimum separation distance.¹⁶⁵ Nokia said that the text for such instructions should be submitted to the Commission along with an application for equipment authorization.

94. Cisco gave two examples relevant to the installation issue, suggesting reliance on the manuals accompanying the devices in both cases.¹⁶⁶ The first involved a consumer installing a low power radio device in a laptop or PDA. For devices not excluded from routine evaluation, Cisco suggested that relevant exposure information could be provided in the user manual. In the second case, a consumer self-installs an external transmitter used to extend the range of a wireless networking system. In such cases, Cisco recommended RF safety warnings and instructions on safe installation also be provided in manuals. Furthermore, Cisco believed that consumers likely to install such equipment tend to be "reasonably sophisticated" in their use of RF equipment, so that instructions in manuals should be sufficient to ensure compliance.

95. Wireless Communications Association International (WCA) fully supported the Commission's decision not to propose mandatory requirements for professional installation of subscriber transceiver antennas.¹⁶⁷ WCA argued that safety-related concerns regarding wireless broadband consumer equipment are already addressed by the "safety exception" to the Commission's "OTARD" rules (47 CFR § 1.4000), which prohibits "safety-related" antenna restrictions that impair installation, maintenance or use of subscriber wireless antennas unless they serve a clearly defined and legitimate safety objective. Section 1.4000(c) of our rules additionally requires labeling of fixed transmitting antennas to provide notice of potential RF exposure for the provisions of section 1.4000 to apply.

96. *Discussion.* We again note that many of the comments are made with respect to portable devices, which are not subject to these requirements and were not addressed in the *Notice*. Nonetheless, the ideas and arguments advanced are useful in our consideration for fixed devices. Most commenters appear to agree that providing information on RF exposure, where required and effective, through labels or instructions in user manuals is an acceptable method to ensure compliance with our RF exposure

¹⁶¹ See PalmOne comments at 5.

¹⁶² See Nokia comments at 8.

¹⁶³ See Cisco comments at 15.

¹⁶⁴ See T-Mobile comments at 14-15.

¹⁶⁵ See Nokia comments at 2-3 and 8.

¹⁶⁶ See Cisco comments at 13.

¹⁶⁷ See WCA comments at 1-3.

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limits. For all relevant services involving fixed subscriber transceiver antennas, we are not at this time adopting the modified rules proposed in the *Notice* regarding labeling requirements using criteria based on power and distance in this *Order*. Instead, we are proposing modifications to these rules in the *Further Notice* under a broader scope of mitigation issues dealing with labeling and signage.¹⁶⁸ In our *Notice*, we proposed labeling as sufficient only with respect to devices governed by Parts 21 (Subpart K), 74 (Subpart I), and 101 (Subparts C, G, and L). We are now proposing in the *Further Notice* not to require labels for any fixed subscriber transceiver antenna (or any transmitting antenna in general) if it is demonstrated that the appropriate general population/uncontrolled exposure limits cannot be exceeded in any case, even with persons immediately adjacent to an antenna, which we define as “intrinsic compliance.” We find no basis for requiring labels for situations where the exposure limits cannot be exceeded. However, this makes it particularly important to fully evaluate the required separation distances from subscriber antennas by measurements or modeling. In the interim, while we will continue to require labels in general, they may state that a device is intrinsically compliant with our exposure limits if such is the case. Methods to achieve intrinsic compliance include, for example, the use of radomes or other surfaces to preclude access to non-compliant spatial regions near energized antenna elements or safety “cut-off” devices, discussed above, to reduce or shut down power to an antenna when a person may be in the path of and too close to the source of the RF energy. We find this concept of intrinsically compliant fixed devices to be useful in the context of our discussion in the *Further Notice*, and thus we use this term in the context of our proposals below.¹⁶⁹

97. We have not been presented with any evidence that our present policy of not establishing mandatory requirements regarding professional installation or device design has resulted in non-compliance with the exposure limits. Accordingly, we find no justification for making any changes in this area. We will continue to advise manufacturers and licensees to provide information in user manuals regarding proper and safe installation. We conclude that our labeling requirements, in conjunction with such information in user manuals, if necessary, will be sufficient to ensure that proper caution is taken in the placement of these devices. With respect to Cisco’s comments, we note that the scope of the present discussion involves the labeling of fixed consumer transceiver antennas, not mobile or portable devices.

C. Effective Date

98. *Original Proposal.* In the *Notice*, we recognized that licensees and applicants will need some period of time to become familiar with any changes to our rules that could require additional routine evaluation for some previously excluded transmitters and devices and to modify their processes and procedures accordingly. Therefore, we proposed in the *Notice* to provide a transition period of six months after we adopt any new rules in this proceeding before they become effective. We now defer many of our decisions as proposals in the *Further Notice*, and those adopted here are not as extensive as those we originally proposed. We expect that they can be readily complied with, and so we here adopt an effective date of 60 days after publication in the Federal Register for the final rules in Appendix A.

99. *Comments.* This issue generated a fairly large number of comments. Many commenters favored a more lengthy transition period than the six months proposed. CTIA and other commenters urged the Commission to allow a one-year transition period or longer, maintaining that anything shorter would be overly burdensome.¹⁷⁰ Many of the requests for longer periods of time to transition are premised on the need to re-evaluate sites under the rules proposed in the *Notice*, but we are not modifying our exclusion criteria in this *Order*.

¹⁶⁸ See para. 176 *infra*.

¹⁶⁹ See para. 196 *infra*.

¹⁷⁰ See Cingular comments at 16; CTIA comments at 13-14; Dobson reply comments at 4-6; Ericsson comments at 8-9; Motorola comments at 15; Pinnacle comments at 8-9; T-Mobile comments at 12-14; Winstar comments at 3.

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100. Most commenters strongly urged the Commission to clarify that the new requirements for routine evaluation be applied “prospectively.”¹⁷¹ Many of these commenters urged that we “grandfather” existing sites from evaluation, although a few commenters opposed this.¹⁷² The EMR Network said the Commission would be derelict in its duty to safeguard the public from RF exposure if it allows grandfathered transmitters to remain unexamined. Similarly, RF People opposed grandfathering and maintained that such an action would sweep large numbers of sites with potential RF hazards under the rug. Southern maintained, on the other hand, that a system-wide re-evaluation would constitute an enormous effort, and Sprint similarly noted that the proposals for rooftop antennas are more restrictive than the existing standard, so that a significant number of existing sites could be subject to routine evaluation. This, according to Sprint, would represent an immense burden for licensees, and the Commission should not impose it absent clear and convincing evidence that transmitter sites that have been excluded under the existing rules pose an unacceptable risk of non-compliance. Winstar Communications, LLC (Winstar) similarly asserted that retroactive application of the proposed exclusion criteria could impose unreasonable economic and administrative burdens on wireless providers.

101. T-Mobile concurred that the new rule changes for exclusions from evaluation should be prospective only, because existing facilities have been constructed in compliance with existing guidelines and are, in fact, safe. Also, T-Mobile noted that the Commission’s environmental rules are promulgated pursuant to the NEPA, and the NEPA is a prospective statute, enforceable only prior to the construction of federally-licensed facilities. According to T-Mobile, the courts have consistently held that the NEPA does not authorize relief after the fact of construction, absent bad faith on the part of an agency.¹⁷³

102. Some other commenters proposed that we allow a “concurrent system” of applicability, whereby any new rules would become effective immediately but would not become mandatory until later.¹⁷⁴ During that time period, manufacturers and others would be able to choose between the current or newly adopted rules. Dell, Nokia, and others noted that this would allow industry and consumers to immediately benefit from some of the proposed changes.

103. *Decision.* We will not require a new evaluation of all existing sites that were excluded from evaluation under previous criteria. As pointed out by T-Mobile, the NEPA is a prospective statute.¹⁷⁵ Moreover, even if NEPA or the Communications Act provided discretionary authority to require such existing sites to be evaluated under our new rules, we would find that such evaluation would not be necessary in this case. The rule revisions set forth in Appendix A below are generally procedural. We are not adopting any changes to the exclusion criteria in the rules at this time. In other words, if a site was “categorically excluded” or “exempt” from routine evaluation under the previous rules, it will still be exempt from routine evaluation under the rules we adopt today. We note, however, that regardless of whether a site is exempt from routine evaluation, licensees are required to ensure that existing sites are in

¹⁷¹ See CTIA comments at 13-14; Dobson Communications reply comments at 4-6; NAB comments at 4; Southern Communications comments at 8-9 and reply comments at 3-4; Sprint comments at 3-4; T-Mobile comments at 12-14; Winstar Communications at 3; Wireless Communications Association International (WCA) comments at 2-5.

¹⁷² See EMR Network comments at 2, RF People reply comments at 1-4.

¹⁷³ See T-Mobile comments at 13-14.

¹⁷⁴ See Dell comments at 3; IEEE 802 comments at 8; Nokia comments at 8-9; TIA comments at 13; Wi-Fi comments at 10.

¹⁷⁵ T-Mobile comments at 13-14, citing *Ogunquit Village Corporation v. Davis*, 553 F.2d 243, 246 (1st Cir.1977); *Richland Park Homeowners Ass’n. v. Pierce*, 671 F.2d 935, 941 (5th Cir. 1982), citing *Aertsen v. Landrieu*, 637 F.2d 12, 19 (1st Cir. 1980). See Section 102(2)(C)(i) of NEPA, 42 U.S.C. § 4332(2)(C)(i). See also *Citizens and Landowners v. United States Dept. of Energy*, 683 F.2d 1171 (8th Cir. 1982) (refusing to afford remedy post-construction).

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compliance with our exposure limits.¹⁷⁶ Furthermore, we caution that the Commission may take enforcement action against licensees that do not comply with the exposure limits in the rules, regardless of whether their transmitters were “categorically excluded” or “exempt” from routine evaluation in the past.

104. We have deferred many of the decisions of the *Order* to the *Further Notice*, and so our final changes to the rules in this *Order* are relatively minor, most of which are allowing greater flexibility in determination of compliance and thus are not associated with any increase in cost to affected parties. However, we recognize that any such changes require a reasonable period of time to be implemented. Therefore, we are setting an effective date of 60 days after publication in the Federal Register for the final rules in Appendix A.

D. Deletion of Old Rules and Update of Portable and Mobile Service Evaluation List

105. We note that an administrative change is necessary in the rules dealing with RF exposure. When we last adopted major changes to these rules in 1996 and 1997, we also adopted certain “Transition Provisions.”¹⁷⁷ These transition provisions, contained in sections 1.1307(b)(4) and (5) of our rules, no longer have any effect and are thus not necessary. “All existing transmitting facilities, operations and devices” the Commission regulates were required to be in compliance with section 1.1307(b)(1) through (b)(3), by September 1, 2000 in accord with section 1.1307(b)(5).¹⁷⁸ We state in section 1.1307(b)(1) of our rules that our exposure limits “are generally applicable to all facilities, operations, and transmitters

¹⁷⁶ The Commission’s authority to adopt and enforce RF exposure limits beyond the prospective limitations of NEPA is well established. *See, e.g.*, Section 704(b) of the Telecommunications Act of 1996, Pub. L. No. 104-104 (directing Commission to “prescribe and make effective rules regarding the environmental effects of radio frequency emissions” upon completing action in then-pending rulemaking proceeding that included proposals for, *inter alia*, maximum exposure limits); 47 U.S.C. § 332(c)(7)(B)(iv) (recognizing legitimacy of FCC’s existing regulations on environmental effects of RF emissions of personal wireless service facilities, by proscribing state and local regulation of such facilities on the basis of such effects, to the extent such facilities comply with Commission regulations concerning such RF emissions); 47 U.S.C. § 151 (creating the FCC “[f]or the purpose of regulating interstate and foreign commerce in communication by wire and radio so as to make available, so far as possible, to all the people of the United States, . . . a rapid, efficient, Nation-wide, and world-wide wire and radio communication service, . . . for the purpose of [inter alia] promoting safety of life and property through the use of wire and radio communications”). *See also* H.R. Rep. No. 204(I), 104th Cong., 1st Sess. 94 (1995), *reprinted in* 1996 U.S.C.C.A.N. 10, 61 (1996) (in legislative history of Section 704 of 1996 Telecommunications Act, identifying “adequate safeguards of the public health and safety” as part of a framework of uniform, nationwide RF regulations); *Farina v. Nokia, Inc.*, 625 F.3d 97 (3d Cir. 2010) (affirming that FCC regulation of cell phone RF emissions – including those rules addressing health effects – preempted state lawsuit dependent on claims of adverse health effects from FCC-compliant cell phone RF emissions), *cert. denied*, 132 S.Ct. 365 (2011). In *Farina*, 625 F.3d at 130, the U.S. Court of Appeals for the Third Circuit stated that “[p]rotecting public safety [with RF emissions regulation] is clearly within the mandate of the FCC,” observing that “although the FCC’s RF regulations were triggered by the Commission’s NEPA obligations, health and safety considerations were already within the FCC’s mandate, 47 U.S.C. §§ 151, 332(a), and all RF regulations were promulgated under the rulemaking authority granted by the [Communications Act of 1934, as amended].” *Id.* at 128. The court also recognized that in promulgating RF exposure standards, the Commission was not only acting in accordance with its public safety mandate, but also in accordance with its mandate to ensure the rapid development of an efficient and uniform nationwide communications system: “In order to satisfy both its mandates to regulate the safety concerns of RF emissions and to ensure the creation of an efficient and uniform nationwide network, the FCC was required to weigh those considerations and establish a set of standards that limit RF emissions enough to protect the public and workers while, at the same time, leave RF levels high enough to enable cell phone companies to provide quality nationwide service in a cost-effective manner.” *Id.* at 125.

¹⁷⁷ *See* 47 CFR §§ 1.1307(b)(4) and (5).

¹⁷⁸ *See* 47 CFR § 1.1307(b)(5).

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regulated by the Commission.” Thus, there are no facilities operating pursuant to the requirements in effect before the transition period that would become non-compliant with the rules as a result of the elimination of the transition period. Moreover, there are no pending enforcement cases where compliance with the transition deadline is at issue. We are, therefore, *sua sponte* deleting these transition provisions from this rule part.

106. We also note that we are making necessary minor administrative changes for clarification and consistency between sections 1.1307(b)(2), 2.1091(c), and 2.1093, which list services requiring routine RF evaluation for portable and mobile devices. Specifically, we add “Miscellaneous” to all three sections to correctly name the Miscellaneous Wireless Communications Service defined by part 27 of our rules; we add “the 4.9 GHz Band Service” and “the Medical Device Radiocommunication Service (MedRadio)” to section 1.1307(b)(2) to reflect their inclusion in section 2.1093(c); and we add “the 3650 MHz Wireless Broadband Service” to sections 2.1091(c) and 2.1093(c), since this change was already adopted in the Report and Order in ET Docket 04-151, published in the Federal Register on May 11, 2005, but was never actually incorporated into the Code of Federal Regulations. These changes do not affect evaluation requirements for compliance or applicability of these sections to portable or mobile devices.

107. The regulatory changes discussed in the two preceding paragraphs do not require prior notice and opportunity for comment. Under the Administrative Procedure Act, notice and opportunity for comment are not required “when the agency for good cause finds (and incorporates the finding and a brief statement of reasons therefor[e] in the rules issued) that notice and public procedure thereon are impracticable, unnecessary, or contrary to the public interest.”¹⁷⁹ Here, the Commission for good cause finds that notice and comment are unnecessary for eliminating 47 C.F.R. §§ 1.1307(b)(4) and (5), because, for the reasons provided in paragraph 105, above, these rules have outlived their purpose and no longer serve any function. Similarly, the Commission for good cause finds that notice and comment are unnecessary for amending 47 C.F.R. §§ 1.1307(b)(2), 2.1091(c), and 2.1093, to the extent and for the reasons provided in paragraph 106.

¹⁷⁹ 5 U.S.C. 553(b)(B). The “unnecessary” exception to the notice requirement is “confined to those situations in which the administrative rule is a routine determination, insignificant in nature and impact, and inconsequential to the industry and to the public.” *Utility Solid Waste Activities Group v. EPA*, 236 F.3d 749, 755 (D.C. Cir., 2001) citing *Texaco v. FPC*, 412 F.2d 740, 743 (3d Cir., 1969). “‘Unnecessary’ refers to the issuance of a minor rule or amendment in which the public is not particularly interested.” *Texaco*, 412 F.2d at 743 n.3.

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IV. FURTHER NOTICE OF PROPOSED RULE MAKING

108. This *Further Notice of Proposed Rulemaking* (*Further Notice*) focuses on specific items not acted upon in the *Report and Order* (*Order*), which that have either been raised or have evolved significantly since the *Notice*.¹⁸⁰ In summary, this *Further Notice* proposes: new power- and distance-based exemptions¹⁸¹ that streamline the determination of whether preparation of a routine radiofrequency (RF) evaluation is necessary; post-evaluation mitigation procedures to ensure that people are not exposed to RF levels that exceed prescribed limits (procedures that include use of labels, signs, and barriers); and clarifications to our rules involving the use, in the RF evaluation process, of calculation or measurement methodologies to determine potential exposure levels. Consistent with the scope of discussion of the *Notice*,¹⁸² this *Further Notice* does not invite comment on the exposure limits themselves; however, with the *Inquiry* portion of this document, set out below, we initiate a new proceeding that will reexamine the efficacy of these limits to determine whether any changes are warranted.

109. In proposing, in this *Further Notice*, changes to our RF safety rules, our intent is to appropriately protect the public without imposing an undue burden on industry. While acknowledging the potential difficulty of quantifying benefits and burdens, we need to determine whether the overall costs of the regulation are outweighed by the benefit to consumers, workers, and other members of the public. We therefore request comment, below, on a wide range of questions that will enable us to weigh those costs and benefits of our proposed rules. We also request comment on the most cost-effective approach for modifying existing policies and practices to achieve the goals of our proposed rules while still ensuring appropriate protection of the public. For each cost or benefit addressed, we ask that commenters provide specific data and information such as actual or estimated dollar figures, including a description of how the data or information was calculated or obtained and any supporting documentation. All comments will be considered and given appropriate weight. Vague or unsupported assertions regarding costs or benefits generally will receive less weight and be less persuasive than the more specific and supported statements.

A. Definition of Terms Related to our Further Proposals

110. *Summary.* Comments received in response to the *Notice* requested consistent terminology when referring to “power” in general. Various commenters also raised issues that are related, at least in part, to our existing rules for categorical exclusions. We thus propose clarification of our definitions related to power and propose a new definition of “exemption” as applied to routine evaluation, both of which are relevant to our further proposals.

111. *Comments.* In the current rules, the term “total power of all channels” means the sum of the total ERP of all channels defined as “all co-located simultaneously operating transmitters owned and operated by a single licensee.”¹⁸³ Dr. John Moulder¹⁸⁴ noted that the proposed rule amendments appended to the *Notice* do not include this language. Dr. Moulder strongly urged the Commission to maintain the present definition and to broaden it to include all co-located transmitters at a given site, not just those operated by a single licensee.¹⁸⁵ Some commenters noted that the terms used for “power” in the *Notice*

¹⁸⁰ See *Notice of Proposed Rule Making (Notice)*, ET Docket 03-137, *Proposed Changes in the Commission’s Rules Regarding Human Exposure to Radio frequency Electromagnetic Fields*, 18 FCC Rcd 13187 (2003) at paras. 1-5.

¹⁸¹ See an explanation of the use of the term “exemption” instead of “categorical exclusion” in footnote 29 *supra*.

¹⁸² See *Notice* at para. 5.

¹⁸³ See 47 CFR § 1.1307(b)(1).

¹⁸⁴ Dr. John Moulder, Ph.D., Medical College of Wisconsin (Dr. Moulder).

¹⁸⁵ See Moulder comments at 1-2.

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are not always consistent.¹⁸⁶ For example, Hammett and Edison noted that the text mixes usage of the terms “transmitter power” and “ERP,” and it urged that we maintain the distinction between these terms. Nokia similarly pointed out that the *Notice* uses several terms for power and suggested that we use two terms consistently in the new rules: “maximum time-averaged output power” and “maximum time-averaged ERP/EIRP.” “Time-averaged” would refer to the averaging period specified in the MPE guidelines in section 1.1310 of the rules. As pointed out by BSL in its comments to the *Notice*,¹⁸⁷ use of the term “exclusion” to signify the more limited exemption from performing a routine evaluation for RF exposure may be confusing. BSL also suggested that it is important to make clear that a “routine evaluation” need not be some rigid process requiring a lot of paperwork and, as noted by Richard A. Tell and RF People, exclusion from routine evaluation is not an exclusion from compliance.¹⁸⁸

112. *Further Proposal.* With respect to our use of varied definitions for “power,” we are proposing explicit and consistent power definitions appropriate for the conditions of use and underlying exposure limits. We here clarify for the purposes of our proposals here the definitions that we will use consistently throughout this *Further Notice*. ERP is defined as the product of the net power delivered to the antenna (*i.e.*, excluding reflected and/or dissipated power not transferred to the antenna) and its maximum gain, where the “maximum gain” is the largest far-field total power gain relative to a dipole in any direction for all transverse polarization components. Available power is defined as the matched conducted power when a source having finite internal impedance is perfectly matched to its load. Delivered power is defined as the net power supplied to the load. With respect to time averaging, “time-averaged” for a fixed RF source is an average over any 30 minute time period (or 6 minutes for occupational exposure evaluation but not exemption), in contrast with “time-averaged” for a mobile or portable RF source, which is an average over a period inherent from device transmission characteristics.¹⁸⁹ Combining these definitions, the “maximum time-averaged ERP” for a fixed RF source is the product of the maximum delivered power to the antenna and its maximum gain as averaged over any 30 minute time period;¹⁹⁰ the “available maximum time-averaged power” is the maximum available power as averaged over any 30 minute time period;¹⁹¹ and the “delivered maximum time-averaged power” is the net maximum delivered or supplied power as averaged over any 30 minute time period.¹⁹²

113. We are also proposing a modification to the terminology we use in the context of providing for “exclusions” from routine evaluation. The National Environmental Policy Act of 1969 (NEPA), 42 U.S.C. 4332(2)(C), requires an Environmental Impact Statement (EIS) for a major federal action that significantly affects the quality of the human environment. Under regulations promulgated by the Council on Environmental Quality (CEQ) to implement this procedural responsibility, an agency may utilize a briefer Environmental Assessment (EA) to determine if an EIS is required and may “exclude” from environmental processing a category of proposed actions that do not have a significant environmental impact.¹⁹³ Section 1.1306 of the Commission’s NEPA procedures, 47 C.F.R. 1.1306, establishes a

¹⁸⁶ See Hammett and Edison comments at 3; Nokia comments at 2-3.

¹⁸⁷ See BSL comments at 2-7.

¹⁸⁸ See Richard Tell comments at 1-2; RF People comments at 1-3.

¹⁸⁹ See para. 222 *infra*.

¹⁹⁰ In contrast, the “maximum time-averaged ERP” for a mobile or portable RF source is the product of the maximum delivered power to the antenna and its maximum gain as averaged over a period inherent from device transmission characteristics.

¹⁹¹ In contrast, the “available maximum time-averaged power” for a mobile or portable RF source is the maximum available power as averaged over a period inherent from device transmission characteristics.

¹⁹² In contrast, the “delivered maximum time-averaged power” for a mobile or portable RF source is the net maximum delivered or supplied power as averaged over a period inherent from device transmission characteristics.

¹⁹³ See 40 CFR §§ 1508.4, 1508.9.

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categorical “exclusion” for actions not specifically defined by sections 1.1307(a) or (b), or determined by the processing bureau under sections 1.1307(c) or (d), to have a potentially significant environmental impact that requires the applicant or licensee to prepare an EA. An EA or an EIS is a specialized document, subject to the format and content requirements specified in CEQ rules and the Commission’s rules (*e.g.*, 47 C.F.R. § 1.1311). Other environmental factors besides RF, such as location in a wilderness area or flood plain (see 47 C.F.R. § 1.1307(a)), may require the applicant or licensee to prepare an EA. Thus, a facility that is “exempt” from a routine evaluation for RF exposure may still have other environmental considerations, which precludes “exclusion” from the environmental processing requirements of preparing a formal EA or EIS. Therefore, to avoid confusion, we are proposing a change in the language used in the rules, so that an “exemption” will refer to an exemption from performing a routine RF evaluation, while the term “exclusion” will continue to be used in the context of an exclusion from preparation of any EA or other additional environmental document. Consistent with this proposal, we use these terms in this manner throughout the text of this *Further Notice*.

B. Exemption: Power and Distance Criteria to Streamline Determination of Compliance

114. *Summary.* The Commission’s rules identify particular categories of existing or proposed transmitting facilities for which licensees and applicants are required to conduct routine environmental evaluations to determine whether these facilities comply with our RF guidelines. All other transmitting facilities have been “categorically excluded”¹⁹⁴ from such routine evaluations because we determined that they offer negligible potential for causing exposures in excess of our guidelines, based on factors such as operating power and accessibility.¹⁹⁵ After years of experience in analyzing RF exposure potential from various sources, we proposed in the *Notice* certain modifications to these categories.¹⁹⁶ Current categorical exclusion rules for certain fixed¹⁹⁷ transmitting facilities with similar exposure characteristics are based on combinations of effective radiated power (ERP)¹⁹⁸ and antenna height above ground, so we proposed in the *Notice* relatively minor modifications to the categories in Table 1 of section 1.1307(b) of our rules,¹⁹⁹ considering both total ERP and separation distance, rather than height above ground, to determine whether a routine evaluation is necessary. Separation distance in this context would be defined as the minimum distance from the radiating structure of the transmitting antenna in any direction to any area that is accessible to a worker or to a member of the general public.²⁰⁰ In proposing these rules in the *Notice*, we indicated we were also concerned that the separation distances and ERP levels contained in the

¹⁹⁴ As noted above, in this *Further Notice*, we propose to modify this terminology to refer to an “exemption” from routine evaluation.

¹⁹⁵ Accessibility generally relates to such factors as the height above ground of an antenna or whether an antenna is mounted on a tower or accessible on a rooftop, as well as lateral distance from the closest point of possible human presence.

¹⁹⁶ See section III. A. of the *Notice*.

¹⁹⁷ In this context, we are using the term “fixed” to refer to those transmitters referenced in Table 1 of 47 CFR § 1.1307(b) that are not considered “mobile” or “portable” as defined in 47 CFR § 2.1091 and § 2.1093. This definition includes transmitters that are physically secured at one location on a temporary basis. An example of such a case would be a mobile wireless base station used to accommodate increased call volume at a special event.

¹⁹⁸ Equivalent isotropic radiated power (EIRP) equals ERP times 1.64.

¹⁹⁹ See Appendix A and section III. A. of the *Notice*.

²⁰⁰ These separation distances and power levels were derived from calculations taking into account the current RF safety guidelines and the technical rules governing the affected transmitting facilities contained in the Commission’s rules. See *Notice* at para. 11. Also see the Commission’s OET Bulletin 65 for detailed information on such calculations.

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rules that trigger routine evaluation might not be appropriate in all situations.²⁰¹ For example, under our current guidelines, a cellular transmitting facility with an antenna less than 10 meters high would not be subject to routine evaluation for RF exposure even if it operated at an ERP level that approaches the threshold level for routine RF evaluation (such as 999 W). We made several proposals for routine evaluation and exclusion in the *Notice* and proposed to apply them uniformly across multiple services.²⁰² Here we propose exemption criteria based on power, frequency, and separation distance (rather than antenna height above ground) uniformly across all services (rather than just the services in Table 1 of section 1.1307(b) of our rules).

115. *Comments.* Commenters generally expressed support for our proposals in the *Notice* to make the RF exposure rules simple and more consistent across service categories.²⁰³ However, various commenters also advocated modifying certain of the proposed exclusion criteria to eliminate additional evaluations.²⁰⁴ Cisco and Southern proposed that rather than using discrete cut-off values, the exclusion criteria should be a continuous “sliding scale” formula of transmitter power versus separation distance.²⁰⁵ Based on its evaluation of several hundred communications sites where changes in transmitting facilities have occurred, Global recommended that both the proposed separation distance and output power criteria be reduced.²⁰⁶ Other commenters contended that the Commission mostly struck an appropriate balance in proposing exclusion criteria based on separation distance and power.²⁰⁷

116. Some commenters acknowledged that the proposed changes would likely increase the number of new facilities requiring routine evaluation, but they viewed the changes as “positive” and likely to improve both levels of confidence and compliance efficiency.²⁰⁸ Professor John Moulder noted that the proposed rule changes would make the Commission’s exclusion criteria much easier to explain to non-technical audiences concerned about exposure from wireless base stations.²⁰⁹ According to T-Mobile, the proposed rules would not be significantly more burdensome than procedures already being used by it and other wireless carriers to determine whether facilities are excluded from environmental processing.²¹⁰ T-Mobile also encouraged the Commission to issue additional technical guidance to licensees and applicants to help confirm compliance at transmitter sites.²¹¹

²⁰¹ See *Notice* at para. 9.

²⁰² See *Notice* at paras. 9-16.

²⁰³ See, for example, CTIA comments at 1; Dell comments at 1; Ericsson comments at 1; IEEE 802 comments at 1-4; ITI comments at 2-3; Motorola comments at 3-5; Nokia comments at 1; Pinnacle comments at 2-4; Sirius Satellite Radio, Inc. (Sirius) comments at 1-3; T-Mobile comments at 1-2; TIA comments at 4-6; Wi-Fi comments at 4-5; WCA comments at 1-2; and XM Radio comments at 1-2.

²⁰⁴ See AT&T comments at 1; Cingular comments at 3-12; CTIA comments at 3-7; Dobson reply comments at 3-4; Ericsson comments at 3-4; Motorola comments at 3-5; Moulder comments at 2; Nokia comments at 2-3; Pinnacle comments at 2-4; Southern comments at 2-7 and reply comments at 2-6; Sprint comments at 2; TIA comments at 4-6; Winstar comments at 2-3.

²⁰⁵ See Cisco comments at 4-7; Southern comments at 2-7; reply comments at 5-6.

²⁰⁶ See Global comments at 1.

²⁰⁷ See T-Mobile comments at 4-11; reply comments at 3-4; Sirius comments at 1-3; BSL comments at 8; Pinnacle comments at 2-4.

²⁰⁸ See, e.g., T-Mobile comments at 4-11.

²⁰⁹ See Moulder comments at 2.

²¹⁰ See T-Mobile comments at 6.

²¹¹ See T-Mobile comments at 7.

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117. Other than comments that suggested the use of additional criteria or a continuous sliding scale formula, described above, most comments regarding specific criteria for separation distance and power were directed at low-power (close proximity) installations. Many commenters supported our proposals for exclusion thresholds for low-power fixed transmitters.²¹² For example, T-Mobile believed the proposed thresholds combine a high degree of safety with reasonable efficiency. T-Mobile submitted test data that it asserted indicate that exposure levels drop significantly within a very short distance from the face of typical “microcell” base station antennas and are typically about 50% of public MPE limits at 20 cm.²¹³ Motorola and the Telecommunications Industry Association (TIA) supported the proposed low power exclusion thresholds, provided that antenna gain in different directions can be used to calculate ERP.²¹⁴ Nokia asserted that the power thresholds proposed, coupled with the 20 cm separation requirement, would provide the public with sufficient protection while ensuring that these devices can be installed without delay.²¹⁵ IT’IS expressed concern that the bases for the minimum distances proposed, and for which evaluations would be required, were not obvious and urged that these distances be justified based on expert agreement so that they will ensure the basic restrictions in terms of whole-body and spatial peak specific absorption rates (SARs) are met under all circumstances.²¹⁶

118. On the other hand, CTIA and Cingular stated that the proposed exclusion thresholds for very low power transmitters were too restrictive.²¹⁷ CTIA supported the adoption of exclusion thresholds but argued that the proposal did not take into account low power transmitters operating at slightly higher power levels that were slightly farther from people who are transient through public areas. CTIA recommended that the Commission adopt an intermediate threshold to extend the exclusion to very low-power transmitters normally located at least 60 cm from persons and with power levels slightly higher than those proposed. Cingular maintained that microcell antennas are often mounted in or above ceiling tiles and are typically 2 feet or more above the head of a six-foot adult. Therefore, based on its analysis, Cingular submitted that the power thresholds should be raised to 8 W ERP for frequencies below 1.5 GHz and 26 W ERP for frequencies above 1.5 GHz, both based on a separation distance of 2 feet (60 cm) in front of an antenna. Dobson Communications Corp. (Dobson) concurred that either the Cingular or the CTIA proposal is preferable to the proposed rule.²¹⁸ Southern Communications also supported Cingular’s alternative²¹⁹ and further maintained that because the MPE limits already incorporate a “significant margin of safety,” it is not necessary to add yet an additional margin for low power fixed devices.

119. *Further Proposal.* We propose here to adopt general exemption criteria applying to single RF sources and then further generalized to multiple RF sources in section 1.1307(b) of our rules, described in detail below, based on power, distance, and frequency, for all services using fixed, mobile, and portable transmitters, including implants. We propose that these criteria apply to all of our rules authorizing RF sources – in short, to treat like sources similarly. These proposed criteria based on physical properties are more appropriate than the existing distinctions between service classifications,

²¹² See Ericsson comments at 3-4; IEEE 802 comments at 3-4; ITI comments at 3-4; Nokia comments at 2-3; T-Mobile comments at 11-12; Sirius comments at 1-3; Wi-Fi comments at 4.

²¹³ See T-Mobile comments at 11-12.

²¹⁴ See Motorola comments at 3-5; TIA comments at 4-6.

²¹⁵ See Nokia comments at 2-3.

²¹⁶ See IT’IS comments at 3. Margaret Brown also expresses concern that the proposed exclusion levels could expose individuals to RF levels above the MPE values. However, she provides no basis for this concern, and we will not consider it further. See Margaret Brown comments at 1.

²¹⁷ See CTIA comments at 7-8; Cingular comments at 13-14.

²¹⁸ See Dobson reply comments at 3-4.

²¹⁹ See Southern comments at 2-7, reply comments at 3.

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allow greater simplicity, are technologically neutral, and do not have to be modified to accommodate new or converging services. The exemption thresholds proposed in this *Further Notice* are based on the general population exposure limits because any exposure above the general population limit would need to be evaluated to facilitate awareness of such exposures given our occupational awareness, control, and training requirements in the *Order* adopted herein *supra*.²²⁰ These proposed general exemption criteria for single RF sources, described in detail in Appendices C and D herein *infra*, offer a layered approach to facilitate determination of compliance with our exposure limits. As shown in Figure D-1 of Appendix D, the simplest exemption criteria are the most conservative, while less restrictive exemption criteria, test reduction procedures, or evaluation processes become incrementally more involved, requiring consideration of more specific technical aspects of the RF source for compliance determination as the exposure potential increases. Later in this *Further Notice*, we propose to employ, under certain defined circumstances, generally applicable summation formulas for determining whether multiple RF sources meet proposed exemption criteria.²²¹

120. In the event that RF sources in fact cause human exposure to levels of RF radiation in excess of the limits in section 1.1310 of the rules, a routine RF evaluation or exemption from such an evaluation would not be sufficient to show that there is no significant effect on the quality of the human environment or that the RF sources are categorically excluded from environmental processing. Further, RF sources are subject to review under sections 1.1307(c) and 1.1307(d) of the rules regardless of whether those RF sources have either been determined to be exempt from routine RF evaluation or have been satisfactorily evaluated for compliance. Given the technical complexity of some evaluations, and the assumptions made in deriving the proposed relatively simple exemption criteria herein, there still may be a possibility under atypical circumstances that the procedures to determine compliance are not valid. However, the exemption criteria proposed here should greatly reduce our dependence on review under sections 1.1307(c) and 1.1307(d) for RF compliance. We encourage interested parties to comment on the relative costs and benefits of the proposed changes in this section, as well as those of alternative approaches.

1. Blanket 1 mW Exemption

121. *Summary.* Supported by comments received in response to the *Notice*, we propose here adoption of an exemption from routine environmental evaluation for a single transmitter operating with up to one milliwatt available maximum time-averaged power. This proposed 1 mW exemption threshold for any single transmitter would be independent of frequency and service type.²²² We also propose a minimum two-centimeter separation distance between multiple transmitters operating up to 1 mW and seek comment on whether multiple transmitters using this exemption could under normal operating conditions exceed our exposure limits.

122. Consideration of the fundamental limits on SAR as a function of power is useful for placing a blanket threshold on exemptions from routine evaluation for portable devices. For example, the localized SAR limit of 1.6 W/kg averaged over 1 gram cannot be exceeded if the available power from a transmitter is less than 1.6 mW. This determination is independent of frequency and distance over the applicable SAR frequency range of 100 kHz to 6 GHz. For purposes of establishing the exemption threshold based on conservation of energy, only the available maximum time-averaged power²²³ from a transmitter is relevant.

²²⁰ See para. 75 *supra*.

²²¹ See paras. 139, 142, 154, and 161 *infra*.

²²² See § 1.1307(b)(1) in Appendix B *infra*.

²²³ To obtain the available power from a source having finite internal impedance, the impedance of the load must be matched, that is, equal to the complex conjugate of the impedance of the source as viewed from the output terminals. See para. 112 *supra*.

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123. *Comments.* In comments received in response to the *Notice*, Motorola, Sony Ericsson and Bluetooth SIG, Inc. (Bluetooth SIG) suggested using a SAR-based threshold of 20 mW according to the ICNIRP 2.0 W/kg 10-gram-average SAR limit.²²⁴ Those commenters neglected to proportionally scale this proposed threshold down to the 1.6 W/kg 1-g SAR level required for compliance with our exposure limits.

124. *Further Proposal.* The 20 mW threshold introduced by comments received would be the appropriate threshold for a single transmitter if the Commission exposure limit were 2 W/kg as averaged over 10 grams, which is not the case. Our exposure limit would imply a 1.6 mW threshold for a single transmitter. Similar to the localized SAR limit of 1.6 W/kg being averaged over 1 gram, the extremity SAR limit of 4 W/kg that applies to the pinnae (outer ears), hands, feet, wrists, and ankles is averaged over 10 grams. So, if the available power from a transmitter is less than 40 mW, then the extremity SAR limit cannot be exceeded due to that transmitter operating alone. Likewise, the Commission's localized occupational SAR limit allows 8 W/kg averaged over 1 gram, which would imply an 8 mW exemption threshold, and for extremities where a limit of 20 W/kg averaged over 10 grams is specified, a 200 mW exemption threshold would be appropriate.²²⁵ However, setting a device exemption threshold based on an extremity limit does not necessarily ensure localized SAR compliance beyond that extremity. Further, ensuring a condition where only extremities are exposed is unlikely to be universally practical. As stated previously,²²⁶ our proposed exemption thresholds should be based solely on the general population exposure limits, not occupational exposure limits; thus, an 8 mW blanket threshold for occupational use is not considered appropriate.

125. As a worst-case example, transmitting medical implants have a high potential for most of their energy to be absorbed in one gram of tissue. Considering this case and accounting for device output power measurement variations *in situ*, we propose a single transmitter threshold of 1.0 mW available maximum time-averaged RF output power at frequencies up to 6 GHz for exemption from routine evaluation. Above 6 GHz, we propose the same exemption threshold for continuity, but now based on a reasonably restrictive assumption that the 1 mW of available maximum time-averaged power would be averaged over a contiguous area of 1 cm². Analogous to the use of a 1-g cube for the case of SAR, 1 cm² would be approximately the area of the surface of one side of such a 1-g cube. Thus, the proposed 1 mW exemption threshold is nominally independent of frequency from 100 kHz to 100 GHz. Further, the proposed 1 mW exemption threshold is also independent of service type and is applicable to single fixed, mobile, or portable RF sources. We seek comment on this proposal. We seek comment specifically on whether the 1 mW exemption threshold will be useful in streamlining approval of very-low power implanted and body-mounted medical devices that operate intermittently and with a low transmitter duty cycle.

126. The proposed 1 mW blanket exemption assumes the transmitted power is either absorbed in an approximate cubic centimeter of tissue or incident on a square centimeter of tissue, depending on frequency. Because of these assumed small regions, the likelihood of multiple blanket exempt transmitters significantly exposing the same tissue is small, and that significant overlap in exposure can only occur for blanket exempt transmitting antennas within one centimeter of each other. Based on this consideration, we conservatively propose two centimeters as a required separation distance between any portion of a blanket exempt radiating structure and the nearest portion of any other radiating structure in order to qualify for the 1 mW blanket exemption. Conversely, for the case of multiple transmitters having antennas within two centimeters of each other, we propose that the power from all such transmitters be added together, treated conservatively as a single transmitting antenna, and compared with the blanket 1 mW exemption. We seek comment on whether additive multiple transmitters operating at 1 mW at least

²²⁴ See Motorola comments at 8; Sony Ericsson comments at 4-6; Bluetooth SIG comments at 3-4.

²²⁵ International Electrotechnical Commission, IEC 62479, Draft Edition 1, Distributed March 12, 2010.

²²⁶ See para. 119 *supra*.

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two centimeters apart could under normal operating conditions exceed our exposure limits. We seek further comment on whether addition of a blanket exempt transmitter could cause our exposure limits to be exceeded when other compliant transmitters are present, exempt or not. Additionally, we seek comment on whether the blanket exemption as proposed may not be adequate to prevent exposure over our limits, for example, in a situation involving multiple high-gain millimeter-wave radiators. We encourage interested parties to comment on the relative costs and benefits of the proposed changes in this section, as well as those of alternative approaches.

2. MPE-Based Exemption of Fixed, Mobile, and Portable RF Sources

127. We proposed in the *Notice* to apply existing mobile exemptions to fixed transmitters based on the assumption that both fixed and mobile transmitting antennas would normally operate at least 20 cm from people and thus, evaluation with respect to MPE limits is appropriate. Briefly, instead of defining an invariant power threshold beyond a certain distance, we propose herein to establish varying exemption criteria based on MPE limits for fixed, mobile, and portable RF sources so long as the separation distance for the operating frequency is beyond the distance where the reactive near-field dominates (*i.e.*, at distances beyond $\lambda/2\pi$, where λ is the free-space operating wavelength).²²⁷

a. Single Transmitters

128. *Summary.* In addition to the blanket 1 mW exemption threshold proposed above, we propose here a revised table in section 1.1307(b)(1)²²⁸ that specifies conservative frequency-dependent criteria, as derived in Appendix C, to exempt from routine environmental evaluation a single transmitter operating with up to a calculated maximum time-averaged effective radiated power given a separation distance. Similar to the blanket 1 mW exemption threshold, these exemption criteria for any single transmitter are also independent of service type.

129. *Comments.* As discussed above,²²⁹ most comments received in response to the *Notice* supported the idea of simplifying our criteria and making them consistent across all services. Some also suggested that we consider a “sliding scale”²³⁰ or a more detailed scheme for defining exemptions based on simple calculation methods.

130. *Further Proposal.* Since exposure levels are dependent on power, distance, and frequency, we agree that these suggestions for consistent “sliding scale” criteria across all services have merit and would improve upon our original proposals for exemption criteria in the *Notice*. In addition, power levels and frequencies authorized for new types of transmitters in new and existing services are subject to frequent change, making it difficult to maintain an up-to-date scheme for exemptions from evaluation that is based solely on service category. Therefore, rather than identify these criteria by service, as has been done in the past, we are proposing a revised table for single fixed, mobile, and portable antennas that specifies power and distance criteria for each of the five frequency bands used for the MPE limits that would apply regardless of service category. The new proposed criteria are shown in Table 1 below. We propose to apply these criteria to single fixed, mobile, and portable RF sources at separation distances from any part of the radiating structure of at least $\lambda/2\pi$ in all service categories²³¹ and

²²⁷ See para. 130 and Table 1 *infra*, where the term “ $\lambda/2\pi$ ” is explained in further detail.

²²⁸ See § 1.1307(b)(1) in Appendix B *infra*.

²²⁹ See paras. 115 through 118 *supra*.

²³⁰ See para. 115 *supra*.

²³¹ In the proposed Table 1 below, if $R < \lambda/2\pi$, then evaluation is required. Since $\lambda/2\pi$ is > 20 cm at frequencies below 239 MHz, these exemption criteria do not apply to portable devices that are operated both at less than 20 cm from the body and at frequencies below 239 MHz. In general, less restrictive exemption criteria may be used in accordance with the formulas below Table 2 in para. 153 *infra*, but these portable exemptions are not valid below (continued....)

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to use them to determine whether routine evaluation is necessary. The proposed thresholds in Table 1 are based on the general population maximum permissible exposure (MPE) limits with a single perfect reflection, outside of the reactive near-field, and in the main beam of the radiator, to be compared with the maximum time-averaged effective radiated power. As discussed in Appendix C, these proposed thresholds will generally be conservative in the radiating near-field, but they may not be conservative in the reactive near-field. Reactive near fields dominate at separation distances of less than $\lambda/2\pi$ and may be stronger than the fields calculated based on the far-field gain, particularly in the case of electrically short antennas.²³² In the literature on electrically small antennas, the boundary at the distance $\lambda/2\pi$ is also referred to as a “radiansphere.”²³³ The distance equivalent to $\lambda/2\pi$ may be calculated in meters from $47.7/f$ where f is the frequency in MHz. Appendix C explains in detail how the criteria were derived for Table 1.

Table 1. Single Fixed, Mobile, and Portable Transmitting Antennas Proposed to be Subject to Routine Environmental Evaluation

Transmitter Frequency (MHz)	Threshold ERP (watts)
Regardless of ERP, evaluation is required if the separation distance from the radiating structure, R , is less than $\lambda/2\pi$, where λ is the free-space operating wavelength, unless the available maximum time-averaged power is less than one milliwatt. In addition, evaluation is required if the ERP in watts is greater than the value given by the formula below for the appropriate frequency, f , in MHz at the separation distance, R , in meters.	
0.3 – 1.34	$ERP \geq 1,920 R^2$
1.34 – 30	$ERP \geq 3,450 R^2/f^2$
30 – 300	$ERP \geq 3.83 R^2$
300 – 1,500	$ERP \geq 0.0128 R^2 f$
1,500 – 100,000	$ERP \geq 19.2 R^2$

131. In the context of the proposed Table 1, we propose to define ERP,²³⁴ as the product of the maximum time-averaged power delivered to the antenna²³⁵ and its maximum gain in any direction relative (Continued from previous page)

300 MHz. Thus, there are no exemption criteria below 239 MHz proposed for portable devices other than the 1 mW blanket exemption.

²³² Environmental Protection Agency, *Near-Field Radiation Properties of Simple Linear Antennas with Applications to Radiofrequency Hazards and Broadcasting*, Tell, Richard A., ORP/EAD 78-4, June 1978.

²³³ See e.g., Proceedings of the IRE, *The Radiansphere Around a Small Antenna*, Wheeler, Harold A., 1959.

²³⁴ The equivalent isotropically-radiated power (EIRP), defined as the product of the maximum time-averaged power delivered to the antenna and its maximum gain in any direction relative to an isotropic antenna, equals 1.64 times the ERP. ERP can be derived from the power spectral density (PSD) (e.g., W/m²/MHz) if the bandwidth (BW) is known, as $ERP = PSD * BW * 4\pi R^2 / 1.64$, where R is the distance used to determine the PSD and generally will not be the separation distance used for determination of exemption. This assumes that power spectral density was determined in the far-field of an antenna.

²³⁵ To obtain the maximum delivered power from a source having finite internal impedance, the impedance of the load is that of the antenna which may not necessarily be matched, that is, delivered power excludes reflected and/or dissipated power not transferred to the antenna.

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to a half-wave dipole. The maximum gain is the largest far-field total power gain relative to a dipole in any direction for all transverse polarization components. The maximum time-averaged power delivered to the antenna is averaged over any 30 minute time period for fixed sources and is averaged over a period inherent to the device transmission characteristics for mobile and portable sources.²³⁶ The term “separation distance” in Table 1 is defined as the minimum distance in any direction, from any part of the radiating structure of a transmitting antenna or antenna array, to the body of a nearby person. For these exemptions to apply, we propose that separation distance shall be required to be maintained for all persons, including those occupationally exposed, during operation at the ERP used for comparison to the applicable formula in the table above.²³⁷ The table above would strictly apply only to single transmitters; however, we propose that it may also be used with multiple fixed transmitters in conjunction with the summations discussed in paragraph 141, or it may be used with multiple mobile or portable transmitters within the same device in conjunction with the summations discussed in paragraph 164, but we propose that these two types of permissible summations may not be used together.²³⁸

132. To the extent that the separation from the source is beyond the distance to the reactive near-field region ($R \geq \lambda/2\pi$), the proposed criteria in Table 1 may also be applied to portable devices, as defined in section 2.1093, or to any antenna operated within 20 cm of the body, or to mobile devices, as defined in section 2.1091, operated at least 20 cm from the body. Somewhat less restrictive specific exemptions from routine evaluation proposed later in this document may be applied regardless of $\lambda/2\pi$ at any distance between 0.5 and 40 cm from the body of a nearby person for both single and multiple transmitters, regardless of service classification.²³⁹ Taken together, either of these proposed exemption criteria, whether MPE-based or SAR-based, if adopted, would be applied at distances between $\lambda/2\pi$ and 40 cm. However, we would apply the SAR-based exemption criteria in cases in which the separation distance is less than $\lambda/2\pi$ but more than 0.5 cm, and only at frequencies between 300 MHz and 6 GHz. Also, we would apply the MPE-based exemption criteria exclusively in cases in which the separation distance is greater than 40 cm at frequencies between 300 MHz and 6 GHz. Finally, we would permit the proposed SAR-based exemption criteria to be combined with the proposed MPE-based exemption criteria for multiple transmitting antennas within the same device where some antennas are between 0.5 and 40 cm from the body and others are at a greater distance.²⁴⁰

133. The formulas in Table 1 are based on worst-case calculations, and it is important to remember that these proposed criteria are intended to identify only situations where further evaluation is necessary. As these proposed exemption criteria are intended to be worst-case, they do not necessarily indicate that a transmitting station is not in compliance with the Commission’s exposure limits; rather they simply point to the need for a more detailed analysis to determine if evaluation is necessary.

134. We expect that this approach to exemption will provide ease of application for licensees and provide a better level of understanding for the public. Also, these proposed criteria are reliably and consistently quantifiable. We agree with those that commented in response to the *Notice* that complex exemption criteria would essentially create the same burden as the routine evaluations they would be intended to excuse and thus would offer no real benefit to licensees. Similarly, in the reactive near-field region at $R < \lambda/2\pi$, development of more complicated general exemptions beyond those proposed here may broaden their applicability but would certainly require a more complex exemption formulation. Additionally, as some commenters pointed out,²⁴¹ a relatively simple approach to exemptions would be

²³⁶ See para. 112 *supra*.

²³⁷ See para. 119 *supra*.

²³⁸ See paras. 142 and 165 *infra*.

²³⁹ See para. 151 *infra*.

²⁴⁰ See para. 164 *infra*.

²⁴¹ See para. 116 *supra*.

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useful to persons who seek a simple tool for independent confirmation of the distance from an individual antenna which would strongly indicate compliance with our rules. Also, broad applicability coupled with a sound technical basis should help provide assurance that additional sources of RF energy do not result in non-compliance with our RF exposure limits. Finally, we note that not all Commission licensees are expert in RF exposure matters, and a simple set of criteria based on readily evident information, *i.e.*, frequency, power, and distance, will help ensure understanding and compliance with our regulations.

135. We propose to apply the power and distance criteria consistently across all services. No commenter took issue with this original general proposal in the *Notice*, and we can find no reason to treat like facilities differently from an RF exposure perspective based solely on the nature of the service provided. While we recognize that services in the past have been exempt because they only involve occupational exposure,²⁴² we are basing these exemptions across all services on the general population exposure limits. By basing our exemption criteria on power and separation distance according to operating frequency, we also avoid problems and confusion that may arise when we approve new services that may have operating characteristics different from those that already exist.

136. We acknowledge that the trade-off in the simplicity of the exemption guidelines we propose may, in some cases, lead to evaluations that a more complex formulation for exemption might have excused. We suggest that this conservative approach in conjunction with the greater simplicity afforded by our exemption guidelines would be likely to offer an additional layer of utility in contrast to more complicated evaluation procedures in our guidance documents. A more detailed evaluation can be, and often is, a simple mathematical calculation that demonstrates compliance, but our ongoing policy to consider other methods and procedures if based on sound engineering practice does not preclude other more complex procedures which sufficiently demonstrate compliance. In the simple case of a roof-mounted antenna or a directional antenna, a routine evaluation can often take into account relevant characteristics of the antenna and the site to readily demonstrate compliance through a calculation. In a more complex case, we recently permitted the use of finite element method (FEM)-based computational modeling as an alternative to finite difference time domain (FDTD)-based computational modeling for evaluation of MedRadio devices.²⁴³ We seek comment on the expected cost associated with performing these calculations compared with existing procedures as well as the benefit of the proposed consistent application of these exemption criteria across all services.

137. With respect to our initial proposal in the *Notice* to exempt low-power single fixed transmitters, we now propose to delete the existing mobile power exemptions²⁴⁴ and apply the new proposed general fixed transmitter power exemptions to mobile and portable devices as well. Since the mobile services currently listed in section 2.1091(c) operate above 800 MHz and tend to be used in non-reflective settings,²⁴⁵ the existing power exemption criteria were based on free-space calculations at 20 cm using the public MPE limits at approximately 800 and 1,500 MHz, and while they are useful for these mobile sources, they are not as generally applicable as the proposed new exemption proposal. The new exemption proposal would allow higher powers at greater distances for both mobile and fixed devices, would apply to all services, and would be valid in possibly reflective environments and at lower frequencies; however, this proposal would necessarily reduce the exemption power for mobile devices used at 20 cm. For example at frequencies above 1,500 MHz, this proposed MPE-based exemption power would be reduced by a factor of 4 to an ERP of approximately 0.75 W at 20 cm, while the

²⁴² See para. 119 *supra*.

²⁴³ See *Order* granting ANSYS Inc. Request for Waiver of 47 CFR § 1.1307(b)(2) of Commission Rules, ET Docket 10-166, 26 FCC Rcd 1034, Adopted Feb. 1, 2011.

²⁴⁴ 47 CFR 2.1091(c) of the rules specifies 1.5 or 3.0 W ERP (depending on frequency) for categorical exclusion of mobile antennas for separation distances greater than 20 cm.

²⁴⁵ See para. 66 of *Report and Order* in ET Docket 93-62 (Guidelines for Evaluating the Environmental Effects of Radio frequency Radiation), 11 FCC Rcd 15123 (1996).

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proposed SAR-based exemption criteria would allow an ERP of approximately 3 W at 20 cm up to 40 cm.²⁴⁶ Further, a maximum time-averaged ERP of up to 6.9 W at 60 cm would be exempt for a single antenna using the proposed MPE-based exemption criteria.²⁴⁷ We seek comment on whether these proposals are acceptable alternatives to the values suggested by CTIA and Cingular in their comments.²⁴⁸ Devices installed in ceilings at a separation distance of 60 cm (about 2 feet) or greater would be covered under these new proposed criteria without special consideration. We also reiterate here that these proposed criteria are simply meant to determine whether an evaluation is required. Once that has been determined, such an evaluation need not necessarily be a complex or difficult task. As has been and will continue to be the case, an affected party may undertake an evaluation in lieu of determining exemption status. Parties that determine that they are not exempt, as well as parties that do not determine exemption status, must perform an evaluation.

138. As stated previously, one goal of the general exemptions from routine RF exposure evaluation proposed here is to avoid specific exemptions for particular services and ensure a consistent set of rules without exceptions. Thus, we propose to delete the special exemptions from evaluation in the Amateur Radio Service in section 97.13(c) of our rules. We appreciate that amateur radio operators are knowledgeable about the appropriate use of their equipment such that separation distances are likely to be maintained to ensure compliance with our exposure limits. However, since the existing amateur exemptions are based only on transmitter power and do not consider separation distance or antenna gain, exempt transmitting antennas that are unusually close to people could potentially lead to non-compliant exposure levels. For example, a separation distance of at least 24 feet would meet our proposed exemption criteria, considering a currently-exempt 50-watt transmitter at VHF in accord with section 97.13(c) and assuming an antenna gain of 6 dBi. Existing classification of amateur exposure as occupational²⁴⁹ is consistent with use of our proposed general exemption criteria based on general population exposure limits because awareness of exposure greater than the general population limits is required in all occupational settings, including amateur households.²⁵⁰ Application of the general exemptions proposed here to amateur radio installations would preclude the possibility of overexposure and require further evaluation only when necessary, giving guidance for both fixed and mobile transmitting antennas. We invite comment as to the impact of this proposal on the amateur community. Parties that support maintaining the current exemption based on power alone are requested to explain how it provides adequate assurance that the public is protected against exposure to RF energy in excess of our limits and the extent of the burden imposed by this proposal. We encourage interested parties to comment on the relative costs and benefits of the proposed changes in this section, as well as those of alternative approaches.

b. Multiple Fixed Transmitters

139. *Summary.* Multiple transmitters are commonly collocated on the same structure, for example either a tower or a building. Also, multiple towers are often collocated close to one another, for example on an antenna farm. Thus, exemptions that apply only to single fixed transmitters are of limited practical use in such situations. Since the use of the proposed exemptions in Table 1 (above) and Table 2 (below) are limited to single transmitters, we propose here a summation procedure to determine whether multiple fixed transmitters using these tables are collectively exempt from evaluation. Mobile and portable transmitters within a device are not included in this summation but are considered below.

²⁴⁶ See para. 151 *infra*.

²⁴⁷ See para. 130 *supra*.

²⁴⁸ See para. 118 *supra*.

²⁴⁹ See § 1.1310(e)(4) in Appendix A *infra*.

²⁵⁰ See para. 77 *supra*.

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140. *Comments.* In the *Notice*, we proposed a separation distance criterion for some fixed transmitters.²⁵¹ As mentioned previously, comments we received suggested we consider a “sliding scale”²⁵² or a more detailed scheme for defining exemptions based on simple calculation methods. Based on those comments, we proposed in the *Further Notice* above to define exemptions for single RF sources on the basis of power, distance, and frequency.²⁵³ As discussed in the *Order* herein *supra*,²⁵⁴ many of the comments we received involved apportionment of responsibility at multiple-use fixed transmitter sites. Although this issue of responsibility was not specifically initiated by the *Notice* and does not explicitly relate to exemptions *per se*, it does demonstrate the need for consideration of multiple fixed transmitters in the development of these proposed exemption criteria.

141. *Further Proposal.* To quantitatively exempt multiple transmitting antenna configurations and transmitters²⁵⁵ where ambient exposure determined from a previous evaluation (measured or computed) may be significant, we propose to apply Table 1 in the previous section to multiple antennas operating in the same 30-minute time averaging period²⁵⁶ as follows: a summation of the fractional contributions to the exemption threshold for each antenna may be determined by calculating the ratio of the maximum time-averaged ERP for the antenna to the appropriate frequency- and distance-dependent exemption threshold calculated using either the formulas in Table 1 *supra* or Table 2 *infra*, summing these ratios, and adding any contributions from RF sources with known SAR²⁵⁷ as well as any significant ambient exposure (expressed as the “ambient exposure quotient,” (AEQ), *i.e.*, a fraction of the MPE that exists in the environment prior to considering the relevant sources) at a specific location, as defined below. An AEQ greater than 0.05 is considered significant.²⁵⁸ If the total is 1 or more, further evaluation would be required. In addition to ERP, if the configuration of a fixed RF source operating between 300 MHz and 6 GHz in frequency permits a minimum separation distance between 0.5 cm and 40 cm or less than $\lambda/2\pi$, we also propose alternatively to the MPE-based exemption criteria that the SAR-based exemption criteria may be used.²⁵⁹

Accordingly, evaluation is proposed to be required if:

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \frac{\sum_{j=1}^b SAR_j}{1.6 \text{ W/kg}} + \sum_{k=1}^c \frac{ERP_k}{ERP_{th,k}} + AEQ \geq 1$$

Where

- a = number of fixed RF sources using Table 2 (paragraph 151).
- b = number of existing fixed RF sources with known SAR.
- c = number of fixed RF sources using ERP, according to restrictions on ERP_k.

²⁵¹ See section III. A. of the *Notice*.

²⁵² See para. 115 *supra*.

²⁵³ See para. 119 *supra*.

²⁵⁴ See para. 84 *supra*.

²⁵⁵ Multiple transmitters using the same physical antenna should be treated as multiple antennas at the same location.

²⁵⁶ See para. 131 *supra*.

²⁵⁷ See para. 20 *supra*.

²⁵⁸ See 47 CFR § 1.1307(b)(3).

²⁵⁹ See para. 132 *supra* and para. 151 *infra*.

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- P_i = the available maximum time-averaged power or the ERP, whichever is greater, for RF source i between 0.5 cm and 20 cm (inclusive).
- $P_{th,i}$ = the threshold power according to Table 2 for RF source i .
- SAR_j = the maximum SAR reported from the j^{th} fixed RF source.²⁶⁰
- ERP_k = ERP of RF source k .
- $ERP_{th,k}$ = exemption threshold ERP for RF source k , either at a distance of at least 20 cm up to 40 cm if using Table 2 or at any distance of $\lambda/2\pi$ or greater, if using Table 1 (paragraph 130).
- AEQ = the ambient exposure quotient (AEQ) for the general population/uncontrolled Maximum Permissible Exposure (MPE)²⁶¹ limit from an existing evaluation at the site of exposure from fixed sources. AEQ is the sum of the quotient(s) of each ambient power density or field strength squared and their respective MPE(s) for a particular frequency, also commonly referred to as “fraction of standard.” Note that the AEQ is due to RF sources not included in the ERP summations.

We seek comment on this proposal. We encourage interested parties to comment on the relative costs and benefits of the proposed changes in this section, as well as those of alternative approaches, including as referenced above, whether and how certain individual transmitters at a multiple transmitter site can be exempted.

c. Summation for RF Sources without Definable Physical Relationships is not Required

142. *Summary.* Given our summation proposals applicable for exemption of more than one transmitter depending on whether the transmitters are fixed or are mobile or portable, we posit that exposure summation of fixed transmitters with either mobile or portable devices is impractical and is not proposed to be required for exemption calculations since there is no inherent spatial relationship between fixed transmitters and either mobile or portable devices. However, we propose that summation of multiple mobile and portable transmitters is required when the transmitters are associated with a single device.

143. *Further Proposal.* While it is reasonable to sum exposure due to all well-characterized sources, we see no practical method to quantitatively determine compliance for multiple RF sources that have no fixed physical relationship to one another. There is no definite positional relationship between multiple mobile/portable devices or between such devices and fixed transmitters. However, particularly for localized SAR, consideration of the typical spatial separation between RF sources diminishes the practical relevance of this issue. More simply, we expect that the locations of maximum SAR in the body from different RF sources do not normally overlap. For these reasons, summation of potential exposure due to spatially uncorrelated sources is not routinely required and is consistent with all known compliance activities to date. First, an environment containing a portable or mobile device may also experience highly variable and location-dependent exposure from fixed RF sources. Since exposure diminishes exponentially with increasing distance, additional signal losses occur due to non-line-of-sight conditions from distant sources, and separation from fixed sources is typically large, exposure from fixed RF sources is normally much less than the limit. Moreover, we expect that exposure from devices near a person’s body would generally be more significant than exposure from distant fixed RF sources. Secondly, exposure from each portable or mobile device near a person will generally be highly localized, affecting only a specific small area of body tissue and thus may be considered independent of other portable or mobile devices close to the body, which would affect another area or areas of body tissue. Additionally, highly localized exposure would not result in significant contributions to whole-body average SAR.

²⁶⁰ See para. 158 *infra*.

²⁶¹ See Table 1 of 47 CFR § 1.1310 for MPE limits.

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Thus, for multiple exempt RF sources without an inherent spatial relationship, regardless of their classification as fixed, mobile, or portable, it is not likely that the localized or whole-body SAR limits would be exceeded.

144. We therefore propose to not require exemption summations where there is no inherent spatial relationship between RF sources. However, we emphasize that we will continue to routinely consider summation of multiple mobile and portable transmitters (including modular transmitters that may be installed) for the purpose of evaluation and/or FCC Laboratory test reduction procedures as long as these transmitters are within a single device and a clear spatial relationship among multiple transmitters within this single device is apparent. Notwithstanding this policy, we emphasize sections 1.1307(c) and (d) of the Commission rules would require further environmental processing if the staff determined, on its own or based upon the allegations of an interested party in a written petition, that the particular use of a device(s) ordinarily exempt from routine RF evaluation exceed(s) the applicable exposure limits. We solicit comment on this proposed approach to multiple transmitters and on the advantages and disadvantages of alternative approaches. We encourage interested parties to comment on the relative costs and benefits of the proposed changes in this section, as well as of any alternative approaches identified.

3. SAR-Based Exemption of Fixed, Mobile, and Portable RF Sources

145. *Summary.* One of the topics in the *Notice* was to clarify the procedures for evaluating RF exposure from mobile and portable devices. This included proposals on requirements for: (1) evaluating the SAR of certain unlicensed devices authorized under section 15.247;²⁶² (2) RF evaluation of modular transmitters;²⁶³ and (3) SAR requirements for multiple transmitting devices operating at the same time.²⁶⁴ The *Notice* requested specific comments concerning these subtopics and stated that alternative suggestions should be justified with detailed documentation, data, or observations relevant to potential human exposure from RF emissions.²⁶⁵

146. *Comments.* Among comments we received, which included many alternative but not necessarily well supported suggestions,²⁶⁶ there was also significant general support in response to the *Notice* for power- and distance-dependent exemption thresholds for portable devices. IT'IS recommended that the Commission issue distance-dependent and frequency-dependent exemption thresholds based on worst-case considerations.²⁶⁷ Qualcomm proposed that section 2.1091(c) of the rules be amended to state requirements in terms of power level, not technology, for mobile devices.²⁶⁸ Cisco stated that a single "frequency independent" power threshold is overly restrictive and noted that it and ITI were studying the effects of frequency on SAR values but the complete results of this study were not yet available.²⁶⁹

147. *Further Proposal.* In the previous section, we propose exemption criteria strictly based on MPE limits for all services. Here we propose to establish additional exemption criteria based primarily on SAR limits for fixed, mobile, and portable RF sources near a human body, when the

²⁶² See section III. B. of the *Notice*.

²⁶³ See section III. C. of the *Notice*.

²⁶⁴ See section III. D. of the *Notice*.

²⁶⁵ See *Notice* at para. 1.

²⁶⁶ See, e.g., Appendix H *infra* at Sections 1 and 2.

²⁶⁷ See IT'IS reply comments at 1.

²⁶⁸ See Qualcomm comments at 9. Qualcomm erroneously referred to Section "2.109(c)(1)," rather than to "2.1091(c)."

²⁶⁹ See Cisco comments at 9-10.

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separation distance may be less than $\lambda/2\pi$. These proposed additional exemption criteria are applicable between 300 MHz and 6 GHz in frequency and between 0.5 cm and 40 cm in separation distance. We seek comment on this proposal. We encourage interested parties to comment on the relative costs and benefits of the proposed changes in this section, as well as those of alternative approaches.

a. Single Transmitters

148. *Summary.* In addition to both the blanket 1 mW exemption threshold and the MPE-based exemption criteria proposed above, we propose here a frequency-dependent formula in section 1.1307(b)(1)²⁷⁰ to determine whether a single transmitter operating with up to a calculated maximum time-averaged effective radiated power or available maximum time-averaged power, given a separation distance, is exempt from routine environmental evaluation. This proposed exemption threshold, derived in Appendix D and based on a simple model of SAR, applies to single transmitters at any prescribed separation distance between 0.5 and 40 centimeters. Similar to the proposed exemptions above, this proposed exemption threshold is also independent of service type.

149. *Comments.* Near-field energy absorption in tissues depends upon both the frequency and the separation distance between a user and the RF source. Issues dealing with frequency- and distance-dependent thresholds, antenna gain and impedance, traffic-based duty factors, and conducted versus effective radiated power thresholds were identified in some of the comments in response to the *Notice*; however, detailed analyses and substantiation were generally not given.²⁷¹ Although well-defined thresholds and detailed analyses are thus unavailable from these comments, the need for frequency-, power-, and distance-dependent SAR-based thresholds to streamline SAR test requirements were expressed both directly and indirectly.

150. *Further Proposal.* The need is apparent for simple frequency- and distance-dependent average power thresholds to address exemptions from SAR testing of portable devices, such as cordless phones and various wireless LAN transmitters. However, we recognize that there are other important variables besides frequency, distance, and power that affect the SAR; these variables include antenna type and impedance (and its relationship to RF current) and must be treated conservatively in order to define thresholds that will avoid exemption of devices with unusual antenna configurations that could result in a SAR above the limit. For the model used to develop our proposal, we found a 4.5 to 7.4 dB margin above the SAR calculated for half-wave dipoles was adequately conservative (see Appendix D) to account for the possibility of electrically small low-impedance antennas having an associated higher RF current and magnetic field, potentially resulting in a SAR increase relative to a half-wave dipole. To qualify for the proposed exemption, we would require both the ERP and matched or available conducted power to be less than the threshold. This consideration is to avoid problems with high gain or poorly matched antennas. The derivation of these proposed SAR-based exemption thresholds shown in Table 2 below are detailed in Appendix D.

151. We propose general frequency and separation distance dependent maximum time-averaged power thresholds for any RF source (*i.e.*, portable, mobile, and fixed) to support an exemption from SAR testing between 300 MHz and 6 GHz in frequency and between 0.5 cm and 20 cm in separation distance. Additionally, in this same frequency range, we propose to extend the values obtained at exactly 20 cm from that distance to 40 cm for mobile devices so that will be continuous with the exemption criteria in Table 1 at 40 cm. Further, these exemption criteria are proposed to be applied to single fixed transmitters at any prescribed separation distance between 0.5 and 40 cm in this same frequency range, since there is no restriction on separation distance for sources classified as fixed.

152. The proposed thresholds are derived according to the frequency-, power-, and distance-dependent criteria for single transmitters. For convenience, the proposed thresholds for select frequency

²⁷⁰ See § 1.1307(b)(1) in Appendix B *infra*.

²⁷¹ See, *e.g.*, Appendix H *infra* at Sections 1 and 2.

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bands are listed in Table 2 below for select distances. However, the formulas below the table define the proposed SAR-based exemption thresholds in general for either available maximum time-averaged power or maximum time-averaged ERP, whichever is greater.²⁷² If the ERP of a portable device is not easily obtained, we propose that available power may be used (*i.e.*, without consideration of ERP) for comparison with the proposed criteria below only if the device antenna(s) or radiating structure(s) do not exceed an electrical length of $\lambda/4$.²⁷³ As for devices such as “leaky” coaxial distribution systems, RF heating equipment, and devices in general where the gain is not well defined but always less than that of a half-wave dipole, we propose that the RF power generated by the device may be used in place of the ERP in comparison with either the MPE-based or the SAR-based exemptions, depending on separation distance and frequency.

153. The proposed exemption threshold, P_{th} , is defined in terms of maximum time-averaged power and in accordance with the source-based time averaging requirements described in section 2.1093(d)(5). Time-averaged power measurements are necessary to determine if the maximum output of a transmitter is above or below the proposed threshold for exemption or routine SAR evaluation. The power measurement and SAR test procedures required to determine the number and types of SAR tests necessary to demonstrate device compliance will be available in procedures established by the OET Laboratory at www.fcc.gov/oet/ea. Information describing the method used to derive these proposed frequency- and distance-dependent power thresholds can be found in Appendix D.

²⁷² For some portable devices, ERP, defined as the product of the maximum time-averaged power delivered to the antenna and its maximum gain in any direction relative to a half-wave dipole, may not be readily available. As discussed in the previous section, equivalent isotropically-radiated power (EIRP), defined as the product of the maximum time-averaged power supplied to the antenna and its maximum gain in any direction relative to an isotropic antenna, equals 1.64 times the ERP. ERP can be derived from the power spectral density (PSD) (*e.g.*, W/m²/MHz) if the bandwidth (BW) is known. $ERP = PSD * BW * 4\pi d^2 / 1.64$, where d is the distance used to determine the PSD and generally will not be the separation distance used for determination of exemption. This assumes that power spectral density was determined in the far-field of an antenna.

²⁷³ See Harrington, R. F., *Effect of Antenna Size on Gain, Bandwidth, and Efficiency*, Journal of Research of the National Bureau of Standards, Radio Propagation, Vol. 64D, No. 1, January-February 1960, pp. 1-12.

Table 2. Time-Averaged Power Thresholds for Single Portable, Mobile, and Fixed Transmitting Antennas Proposed to be Subject to Routine Environmental Evaluation

Distance (cm)	Frequency (GHz)															
	0.5	1	1.5	2	2.5	5	7	10	12.5	15	17.5	20	40	610	920	1700
	0.3	39	65	88	110	130	220	280	360	430	490	550	610	610	920	1700
	0.45	22	44	67	89	110	230	320	460	570	690	800	920	920	920	1700
	0.835	9.2	25	44	66	90	240	390	640	880	1100	1400	1700	1700	1700	1700
	0.9	8.3	23	42	63	88	240	400	670	920	1200	1500	1800	1800	1800	1800
	1.45	4.3	15	30	50	74	250	460	870	1300	1800	2300	3000	3000	3000	3000
	1.8	3.5	13	26	45	67	240	450	860	1300	1800	2400	3060	3060	3060	3060
	1.9	3.4	12	26	44	66	240	440	850	1300	1800	2400	3060	3060	3060	3060
	2.45	2.7	10	22	38	59	220	420	820	1300	1800	2400	3060	3060	3060	3060
	3	2.3	9.0	20	35	53	210	400	790	1200	1700	2400	3060	3060	3060	3060
	5.2	1.5	6.3	15	26	42	170	350	730	1200	1700	2300	3060	3060	3060	3060
	5.8	1.4	5.9	14	25	40	170	340	720	1100	1700	2300	3060	3060	3060	3060

Evaluation is required if either matched conducted or effective radiated power (ERP) is greater than:

$$P_{th} (mW) = ERP_{20cm} \left(\frac{d}{20 \text{ cm}} \right)^x$$
$$\text{where: } x = -\log_{10} \left(\frac{ERP_{20cm} \sqrt{f}}{60} \right) \text{ and } ERP_{20cm} (mW) = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

Valid only at distances from 0.5 cm to 20 cm and frequencies from 0.3 GHz to 6 GHz. However, values obtained in the formula at exactly 20 cm may be used between 20 and 40 cm.

We seek comment on this proposal. We encourage interested parties to comment on the relative costs and benefits of the proposed changes in this section, as well as those of alternative approaches.

b. Multiple Portable Transmitters

154. *Summary.* As stated previously,²⁷⁴ we propose that summation should be required when multiple portable transmitters are associated with a single device. We propose here a summation to determine whether multiple portable transmitters using Table 2 above collectively are exempt from evaluation.

²⁷⁴ See para. 142 *supra*.

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155. *Comments.* In the *Notice*, in our proposal for exemption of transmitter modules, we discussed how devices may incorporate multiple modules for simultaneous transmission.²⁷⁵ As demonstrated in Appendix H,²⁷⁶ we received numerous comments regarding treatment of multiple transmitters in device evaluation. Although the issue of multiple transmitters was not specifically related to exemptions, it demonstrates the need for consideration of multiple portable transmitters in the development of these proposed exemption criteria. Simultaneous transmission over different networks using today's technology further demonstrates the need for new proposals for multiple transmitter exemptions beyond those provided in the *Notice*.

156. *Further Proposal.* To rationally exempt multiple transmitters, some of which may be modular, which are operating at the same time in the same device, further quantitative considerations are necessary. The proposed frequency- and body-to-antenna separation distance-dependent maximum time-averaged power thresholds for exemption from SAR evaluation given in the formulas below Table 2 could also apply to a single isolated licensed or unlicensed portable transmitter or to a single isolated modular or non-modular portable transmitter that operates in the range of 0.3 to 6 GHz, as long as multiple transmitters that operate in the same source-based time averaging period are not present. A conservative extension of these thresholds for use with a set of several transmitters operating at the same time in the same device is proposed below for practical application of these thresholds.

157. We propose that the total fraction of the exemption threshold may be determined by calculating for each transmitter the ratio of the maximum time-averaged power (either available power or ERP, whichever is greater) for the transmitter to the appropriate frequency- and distance-dependent threshold calculated using the formulas below Table 2 and then summing these ratios. If the ratios for all transmitters operating in the same time averaging period are included in the sum and the sum is less than one, the device (*i.e.*, all transmitters within the device) is proposed to be exempt from routine evaluation.

158. For the case where one or more transmitters are being added to a device containing existing transmitters that already required SAR evaluation, we are proposing that the remaining SAR margin be used to potentially exempt the additional transmitter(s). If the sum of the previously measured maximum 1-gram average SAR for the existing transmitters is less than 1.6 W/kg and the sum of the above defined ratios for the transmitters to be added is less than the ratio of the SAR margin to 1.6 W/kg, then the additional transmitters are proposed to be exempt from further SAR evaluation. As an example, for a device with an aggregate maximum measured SAR of 0.9 W/kg for the existing transmitters, the margin is 0.7 W/kg (which is 1.6 W/kg minus 0.9 W/kg), and the ratio of the margin to 1.6 W/kg is 0.44; so if the sum of the power threshold ratios for the additional transmitters is less than 0.44, then the additional transmitters would be exempt from further SAR evaluation for the specific host configurations. We also propose that, in order to use exemption criteria for multiple transmitters, each additional transmitter being added to a device must also be exempt from evaluation for this to apply to avoid small incremental contributions that might approach our exposure limit.

159. Conventionally, the use of maximum time-averaged power requires that the power (and SAR) of multiple transmitters operating in the same time averaging period be summed even if they do not transmit at the same instant. For the purpose of implementing exemption thresholds of products that can operate with multiple transmitters, the proposed formula below must take into consideration all transmitters that can operate at the same time and transmit with or without overlapping transmissions to determine if evaluation exemption applies. The proposed values for P_i and SAR_i are determined according to the source-based time averaging requirements of section 2.1093(d)(5), and summing these values represents conservatively the maximum calculated exposure. As the extent of overlapping transmissions may vary among individual products and host configurations, the details of how to conduct

²⁷⁵ See section III. C. of the *Notice*.

²⁷⁶ See Appendix H, Sections 1 and 2 *infra*, *Localized SAR Summation for Evaluation of Multiple Portable Transmitters and Modular Transmitters Installed in Various End-Use Products*.

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evaluations and determine compliance are generally addressed in FCC Laboratory test procedures. For transmitters operating in the same device and in the same time averaging period, we propose that evaluation is required if:

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \frac{\sum_{j=1}^b SAR_j}{1.6 \text{ W/kg}} + \sum_{k=1}^c \frac{ERP_k}{ERP_{th,k}} \geq 1$$

Where

- a = number of portable transmitters that use P_{th} , including existing transmitters and those being added.
- b = number of existing portable transmitters with known SAR.
- c = number of portable transmitters using ERP, including existing transmitters and those being added.
- P_i = the available maximum time-averaged power or the ERP whichever is greater for portable transmitter i.
- $P_{th,i}$ = the threshold power according to Table 2 above for portable transmitter i.
- SAR_j = the maximum SAR reported for equipment certification from the j^{th} portable transmitter in the device.
- ERP_k = ERP of portable transmitter k.
- $ERP_{th,k}$ = exemption threshold ERP for portable transmitter k, either according to Table 2 above or Table 1 above, as applicable.

160. The above proposed summation scheme for multiple transmitters makes the conservative assumption that antennas that are at the same body-to-antenna or radial distance are also at the same location; that is, the antenna-to-antenna or lateral distance would be zero such that SAR distributions will always overlap to the maximum extent. We seek comment on this proposal. We note that, for some types of equipment, the FCC Laboratory has used the lateral distance between antennas and measured peak SAR locations to reduce testing requirements. This is particularly useful for antennas in portable radiotelephones held against the body where the SAR distributions from antennas located in different parts of the phone do not overlap significantly. This lack of overlap is due to the fact that the lateral distance is large compared to the radial distance. Accordingly, for some specific types of equipment where certain FCC Laboratory procedures apply, consideration of lateral separation has already been implemented in these procedures to streamline evaluation requirements, and this will continue. However, since the necessary lateral antenna-to-antenna or SAR peak location separation distance to avoid significant SAR overlap is a complex function of the radial antenna-to-body distance and antenna characteristics, we are proposing not to allow a general exemption from routine evaluation based on lateral distance at this time. We encourage further development and implementation of more efficient evaluation procedures in this area by the Laboratory and others. We request interested parties to comment on the relative costs and benefits of the proposed changes in this section, as well as those of alternative approaches.

c. Multiple Portable and Mobile Transmitters

161. *Summary.* Devices such as cell phones typically contain only portable transmitters; but devices such as laptops may contain a combination of portable (≤ 20 cm) and mobile (> 20 cm) transmitters. Summation is required when multiple mobile and portable transmitters are associated with a single device. We propose here a summation to determine whether multiple mobile and portable transmitters using either Table 1 or Table 2 above collectively are exempt from evaluation.

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162. *Further Proposal.* A device may contain a combination of portable and mobile transmitters, that is, some at less than 20 cm and some at greater than 20 cm separation distances from the body, respectively. Other devices may contain either only mobile or only portable transmitters. In any case, the fractional contributions to the threshold can be determined according to our proposal by calculating for each transmitter the ratio of the maximum time-averaged power (matched conducted power and/or ERP, as appropriate) for the transmitter and comparing to the appropriate frequency- and distance-dependent threshold using the equations in Table 1²⁷⁷ and below Table 2²⁷⁸ and then summing those ratios. If the ratios for all transmitters in a device operating in the same time averaging period are included in the sum and the sum is less than one, the device (*i.e.* all transmitters within the device) is proposed to be exempt from routine evaluation. We propose that all transmitters must be included in the summation of multiple transmitters in a device, including those that may be added subsequently under our permissive change authorization procedures.

163. For devices that have already been evaluated for compliance based on SAR, if one or more portable transmitters are being added, the additional transmitters are proposed to be exempt from further evaluation if all of the following conditions apply: (1) the summation of the ratios of either the available maximum time-averaged power or the ERP, whichever is greater, for the portable transmitters to be added and existing portable transmitters that do not require SAR evaluation to the threshold powers according to the formulas below Table 2; (2) the ratio of the summation of previously measured maximum 1-gram average SAR for the existing portable transmitters to 1.6 W/kg; and (3) the summation of the ratios of the maximum time-averaged ERP for mobile transmitters to the exemption thresholds according to either Table 2 or Table 1 above, as applicable – all sum to less than one.

164. As discussed in previous sections, we propose that the use of maximum time-averaged power would require that the power (and SAR) of multiple transmitters operating in the same time averaging period be summed even if they do not transmit at the same instant. For the purpose of implementing exemption thresholds of products that can operate with multiple transmitters, we propose that the applicant take into consideration all transmitters that can operate within the same time averaging period and transmit with or without overlapping transmissions using the formula below. The values for P_i , SAR_j , and ERP_k , where applicable, are proposed to be determined according to the source-based time averaging requirements of sections 2.1093(d)(5) and 2.1091(d)(2), and the sum of those values represents conservatively the total calculated exposure. The proposed formula may be used even if some of the three terms do not apply (*i.e.*, where those terms would be zero). As the extent of overlapping transmissions may vary among individual products and host configurations, FCC Laboratory test procedures may address the details of how to conduct evaluations and determine compliance for specific types of devices.

Accordingly, for transmitters operating in the same device and in the same time averaging period, we propose that evaluation is required if:

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \frac{\sum_{j=1}^b SAR_j}{1.6 W/kg} + \sum_{k=1}^c \frac{ERP_k}{ERP_{th,k}} \geq 1$$

Where

- a = number of mobile or portable transmitters that use P_{th} , including existing transmitters and those being added.
- b = number of existing mobile or portable transmitters with known SAR.

²⁷⁷ See para. 130 *supra*.

²⁷⁸ See para. 153 *supra*.

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- c = number of mobile or portable transmitters using ERP, including existing transmitters and those being added.
- P_i = the available maximum time-averaged power or the ERP, whichever is greater, for mobile or portable transmitter i .
- $P_{th,i}$ = the threshold power according to Table 2 above for portable transmitter i .
- SAR_j = the maximum SAR reported for equipment certification from the j^{th} mobile or portable transmitter in the device.
- ERP_k = ERP of mobile or portable transmitter k .
- $ERP_{th,k}$ = exemption threshold ERP for mobile or portable transmitter k , either according to Table 2 above or Table 1 above, as applicable.

165. The ambient exposure quotient (AEQ) proposed to be applicable in the summation of multiple fixed sources is not proposed to be applicable in the summation of multiple mobile and portable sources, because AEQ could vary significantly depending on the spatial location of the device and is thus indeterminate.²⁷⁹ We seek comment on this proposal. We encourage interested parties to comment on the relative costs and benefits of the proposed changes in this section, as well as those of alternative approaches.

d. Portable Transmitters with Operating Frequencies above Six Gigahertz or at Distances Greater than $\lambda/2\pi$

166. The proposed portable device exemptions²⁸⁰ above are derived from SAR and apply only at frequencies below six GHz, because only power density exposure limits apply at higher frequencies. Thus, the third term involving ERP in the formula above (para. 164 but only using Table 1 for $ERP_{th,k}$ values) would be the only term used for the purpose of the development of a proposed exemption determination of multiple transmitters for devices operating above 6 GHz. We therefore propose that above 6 GHz, the more conservative exemptions using the equations proposed in Table 1 must be used for portable devices if the separation distance is greater than $\lambda/2\pi$,²⁸¹ again using only the third term involving ERP in the formula above. In general, any RF source operating above 6 GHz may use only the blanket 1 mW exemption and the MPE-based exemption in Table 1. We seek comment on this proposal. We encourage interested parties to comment on the relative costs and benefits of these proposed changes, as well as those of alternative approaches.

C. Evaluation of Portable Devices

167. Generally, we propose that our policy on recommended best practices for evaluation techniques should be contained in our Bulletins and in other supplemental materials, such as the OET Laboratory Knowledge Database (KDB).²⁸² Evaluation documentation is typically submitted individually as part of the licensing or equipment authorization process and the Commission has the discretion to decide whether any particular routine evaluation process adequately demonstrates compliance with its exposure limits. Changes in technology of devices being evaluated and in the evaluation technology itself make this a rapidly evolving area that is more readily guided by good engineering practice rather than

²⁷⁹ See para. 142 *supra*.

²⁸⁰ See para. 151 *supra*.

²⁸¹ See para. 130 *supra*.

²⁸² See <https://apps.fcc.gov/oetcf/kdb/>.

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specific regulations.²⁸³ Further, the process of evaluation itself can be objectively verified even when various methods are used. We therefore propose to remove material from the rules, as specifically described below, that is more properly addressed by our guidance on evaluation procedures by measurement and computation. This guidance will continue to be updated as necessary in our Bulletins and in other supplemental materials such as the KDB.

1. Consistency in Usage of Any Valid Method for SAR Computation

168. *Summary.* In the *Order*,²⁸⁴ we corrected an inconsistency in our rules to allow either computation or measurement for medical devices in both sections 95.1221 and 1.1307(b)(2) of our rules, but when computation is used, these rules only allow one specific method. Here we propose to allow any valid computational method by removing from our rules the reference to this specific method. We also propose to apply only the 1 mW blanket exemption to medical implant devices.

169. *Further Proposal.* In the *Order* adopted herein,²⁸⁵ we modified section 95.1221 of our rules to remove an inconsistency with section 1.1307(b)(2). This modification allows additional flexibility for MedRadio Service transmitters to demonstrate compliance with SAR limits in section 2.1093 by either finite difference time domain (FDTD) analysis or the submission of SAR measurement data, with the Commission retaining the option of requesting measurement data to support an FDTD analysis, if appropriate. There are other numerical methods that provide equivalent results to FDTD. For example, finite integration technique (FIT) and finite element method (FEM) are two of many examples of discrete computational approximations to Maxwell's equations²⁸⁶ that, when appropriate, may also acceptably predict RF fields in biological media. We are thus proposing to modify the language in sections 1.1307(b)(2) and 95.1221 to allow any valid computational method by removing from our rules specific references to FDTD.²⁸⁷ However, we received significant comments to the *Notice* concerning the reliability of FDTD calculations that would also be of concern for any other numerical method that may be used.²⁸⁸ Thus, we also propose in these sections of our rules to ensure that both the software and models used to compute results submitted to the FCC are fully validated and use standard protocols. Specifically, we propose that computational modeling "must be supported by adequate documentation showing that the numerical method as implemented in the computational software has been fully validated; in addition, the equipment under test and exposure conditions must be modeled according to protocols established by numerical computation standards or available FCC procedures for the specific computational method."²⁸⁹ We seek comment on these proposals. We encourage interested parties to comment on the relative costs and benefits of the proposed changes in this section, as well as those of alternative approaches.

²⁸³ See para. 37 *supra*.

²⁸⁴ See para. 55 *supra*.

²⁸⁵ *Id.*

²⁸⁶ Maxwell's equations are a concise set of equations which form the basis for predicting the behavior of electromagnetic waves.

²⁸⁷ See *Order* granting ANSYS Inc. Request for Waiver of 47 CFR § 1.1307(b)(2) of Commission Rules, ET Docket 10-166, 26 FCC Rcd 1034, Adopted Feb. 1, 2011.

²⁸⁸ See para. 53 *supra*.

²⁸⁹ See Appendix B *infra*, §§ 1.1310 and 2.1093(d)(1).

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2. Removal of Minimum Evaluation Distance Requirement from Rules for Frequencies above Six Gigahertz

170. *Summary.* Currently section 2.1093(d) of our rules requires measurements and calculations to demonstrate compliance for devices operating above six gigahertz (GHz) to be made at a minimum separation distance of five centimeters. We propose to remove this distance limitation from our rules since it appears to be outdated by technological developments.

171. Section 2.1093(d) of our rules states that “[m]easurements and calculations to demonstrate compliance with MPE field strength or power density limits for devices operating above 6 GHz should be made at a minimum distance of 5 cm from the radiating source.” IEEE C95.1-1991 which was a significant consideration in determining our current exposure limits recommended a minimum measurement distance of 20 cm, but we anticipated future revisions of IEEE’s standard to include a minimum 5-cm measurement stipulation. In specifying a 1 cm² area for averaging the spatial peak MPE, IEEE Std C95.1-2005 states that 1 cm² is “a practical limit for spot size at 5 cm or 3 probe diameters (whichever is greater) from an RF source for assessing compliance with the MPE to avoid undesirable coupling between the probe and the source.”²⁹⁰ Consistent with the IEEE standard, we use 1 cm² as a spatial peak averaging area in deriving our 1 mW blanket exemption above 6 GHz proposed herein.²⁹¹ Accordingly, we now propose that accurate measurement over a single square centimeter (or less) is possible considering currently available probes, which have diameters as small as approximately 5 mm (and which would equate to a three-probe diameter minimum measurement distance of 1.5 cm). Additionally, evaluation may also be based on computation, for which there may be no practical limitation on minimum distance.

172. *Further Proposal.* There is no apparent reason why measurement or calculation to demonstrate compliance with MPE field strength or power density limits could not be achieved at distances of less than five centimeters, provided, of course, that proper equipment and techniques are used. The 5-cm minimum distance appears to be no longer appropriate, and we therefore propose to remove it. Further, as discussed previously, we propose that such specific guidance on evaluation is generally inappropriate for the rules and will be documented in our Bulletins or other supplemental materials.²⁹² We seek comment on this proposal. We encourage interested parties to comment on the relative costs and benefits of the proposed changes in this section, as well as those of alternative approaches.

3. Technical Evaluation References in Rules

173. *Summary.* In the *Order* we amended section 2.1093(d)(3) to reference the OET Knowledge Database (KDB),²⁹³ which provides supplemental technical evaluation information and references to informative technical evaluation standards as guidelines, instead of directly referencing such resources in our existing rules. Here we propose to utilize this concept elsewhere within our rules.

174. *Further Proposal.* Consistent citation to OET Bulletin 65 in general was resolved in the *Order* for those rules discussed in the *Notice*;²⁹⁴ however citations in specific rule sections not raised in the *Notice* similarly can lead to out-of-date references or confusing interpretations. As with our action in

²⁹⁰ Institute of Electrical and Electronics Engineers, Inc. (IEEE), *IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*, IEEE Std C95.1-2005, copyright 2006 by the Institute of Electrical and Electronics Engineers, Inc. (IEEE), New York, New York 10016-5997.

²⁹¹ See para. 125 *supra*.

²⁹² See para. 167 *supra*.

²⁹³ See para. 28 *supra*.

²⁹⁴ *Id.*

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the *Order*, we propose to eliminate references in our rules to outside documents or specific editions of OET Bulletins and supplements when offering guidance on acceptable procedures for evaluating compliance. Thus, we specifically propose to remove the reference to IEEE Std C95.3-1991 in section 24.51(c). However, we also note and seek comment on the potential implication of this overarching general proposal as it may affect cross-references by other federal agencies that may utilize our existing guidance that we are proposing to discontinue. Specifically, we note Federal Railroad Administration, Department of Transportation, 49 CFR 236, Appendix E, section (h)(2), which mentions our exposure limits along with OET Bulletin 65 and some of its supplements, including Supplement C which has been retired as a result of our action in the *Order supra*.²⁹⁵ We seek comment on the above proposal. We encourage interested parties to comment on the relative costs and benefits of the proposed changes in this section, as well as those of alternative approaches.

D. Mitigation

175. As stated previously, mitigation matters involve post-evaluation procedures to ensure that our exposure limits are not exceeded. Such measures include labels, signs, barriers, occupational training, and enforcement. Here we review in detail our definitions related to power and clarify issues related to the transient exposure of untrained individuals in controlled environments for short periods of time and the proper use of averaging time, whether “source-based” or “behavior-based.” In this context, we propose that “behavior-based” refers to circumstances where specific behavior may be necessary to maintain compliance. Additionally, we propose to provide further guidance on specific mitigation actions such as proximity restriction and disclosure requirements for fixed RF sources.

176. Fixed RF sources are physically attached to one location, sometimes temporarily, and are not able to be easily moved to another location while transmitting.²⁹⁶ Here we clarify general population and occupational exposure requirements, as well as controlled and uncontrolled exposure requirements, and propose components of RF safety programs, where necessary, based on more recent developments in this area. We also clarify the applicability of occupational exposure limits to transient untrained individuals in controlled environments and establish access restriction and disclosure requirements near fixed sources. As we use the term “exposure limits” herein for fixed RF sources, we are referring to the exposure limits without consideration of “behavior-based” time averaging for indefinite time periods. That is, brief exposure levels higher than the limits, with appropriate controls (except for transient individuals above the occupational limit), may be permitted for shorter exposure times, as long as the average exposure over the specified averaging time is less than the limits.

1. Transient Exposure in Controlled Environments near Fixed RF Sources

177. *Summary.* Our definition of the term “transient persons” in section 1.1310 of our rules could be subject to varying interpretations. Thus, we seek to clarify by proposing a definition of transient exposure with respect to averaging time, where transient individuals in controlled environments should not be exposed in excess of the general population limit considering averaging time, and not in excess of the occupational limit for continuous exposure at any time.

²⁹⁵ See para. 37 *supra*.

²⁹⁶ *cf.* 47 CFR § 2.1091(b) – a mobile device is used in locations other than fixed locations in such a way that a separation distance of at least 20 centimeters is normally maintained. The term “fixed location” means that the device is physically secured at one location and is not able to be easily moved to another location while transmitting. Temporary fixed transmitters such as a “cell-on-wheels” (COW) or a temporary fixed earth station (TFES) are considered fixed sources which may be able to be easily moved to another location, but since these types of transmitters are not licensed to transmit while in motion they would also conform to the proposed description of the term “fixed RF source.”

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178. *Further Proposal.* Since 1996, we have had rules that allow occupational exposure levels to apply to individuals that are transiently exposed if they are made aware of their exposure, even though the exposure is not a consequence of their employment. In the *Order* adopted herein, we established paragraph (e)(1) of section 1.1310 of our rules, which states “[l]imits for occupational/controlled exposure also apply in situations when a person is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure. ... [T]raining is not required for transient persons, but they must receive written and/or verbal information and notification (for example, using signs) concerning their exposure potential and appropriate means available to mitigate their exposure.”²⁹⁷ In the course of this proceeding, it became apparent that this language could be subject to differing interpretations. We seek to clarify the applicability of transient exposure and how to apply our exposure limits in controlled environments with respect to averaging time. Since transient exposure assessment involves consideration of averaging time, we will propose a clarification of averaging time.

179. The 1992 ANSI/IEEE guidelines specify two sets of exposure limits based on the “environment” in which the exposure takes place. These environments are classified as either “controlled” or “uncontrolled.” Controlled environments are defined as locations where “there is exposure that may be incurred by persons who are aware of the potential for exposure as a concomitant of employment, by other cognizant persons, or as the incidental result of transient passage through areas where analysis shows the exposure levels may be above [the exposure and induced current levels permitted for uncontrolled environment but not those permitted for controlled environments].”²⁹⁸ Uncontrolled environments are defined as “locations where there is the exposure of individuals who have no knowledge or control of their exposure. The exposures may occur in living quarters or workplaces where there are no expectations that the exposure levels may exceed [the exposure and induced current levels permitted for uncontrolled environments].”²⁹⁹ The NCRP report designates exposure limits in terms of “occupational” and “general population” exposure; however, it does not provide specific definitions of these terms.³⁰⁰ We generally associate controlled environments with occupational exposures, while uncontrolled environments are associated with general population exposure. Examples of controlled environments include fenced areas near tower sites or antennas on rooftops with locked access.

180. The NCRP report mentions transient exposure in its section about averaging time.³⁰¹ It states that “the 30-min time-averaging period is responsive to some special circumstances for the public at large. Examples are transient passage by the individual past high-powered RFEM sources, and brief exposure to civil telecommunications systems.”³⁰² These “special circumstances” are intended to be “brief and non-repetitive,” involving exposure of “only small groups of the population,” where “the occupational exposure levels are permitted for such cases.”³⁰³ While the former statement seems to support the idea that transient exposure simply involves application of the 30-minute time averaging criteria which is used to apply the general population exposure limit, the latter statement implies that the

²⁹⁷ See Appendix A *infra*, § 1.1310(e)(1).

²⁹⁸ See IEEE C95.1-1991, Section 2 – definition of *controlled environment*.

²⁹⁹ See IEEE C95.1-1991, Section 2 – definition of *uncontrolled environment*.

³⁰⁰ See *Report and Order* in ET Docket 93-62 (Guidelines for Evaluating the Environmental Effects of Radio frequency Radiation), 11 FCC Red 15123 (1996), para. 35.

³⁰¹ See Section 17.4.3, *Time Averaging for the General Population*, NCRP Report No. 86, Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields.

³⁰² *Id.*

³⁰³ See Section 17.4.4, *Special Circumstances for Population Exposure*, NCRP Report No. 86, Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields.

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occupational limit would apply to “special circumstances” involving brief exposure without any specific definition of “brief.”

181. We interpret the terms “transient” and “brief” to imply that the general population exposure limits would apply to transient individuals near fixed RF sources within controlled environments, considering a time averaging period of 30 minutes. In a controlled environment and with supervision, “behavior-based” time averaging such as moving through a specific area promptly would be feasible, while we have not found it to be generally feasible in an uncontrolled environment.³⁰⁴ Thus, we propose the definition of transient exposure with respect to averaging time to mean general population/“controlled,” that is, transient exposure should not exceed the general population limit considering 30-minute time averaging in a controlled environment. Additionally, we propose that transient exposure should not exceed the continuous³⁰⁵ occupational limit at any time, accounting for source-based time averaging. In other words, we propose that behavior-based time averaging may be used in controlled situations to maintain compliance with the general population exposure limits (this is the essence of our transient exposure interpretation), while behavior-based time averaging may not be used to maintain compliance with the occupational exposure limits for individuals classified as transient.

182. As established in the *Order* adopted herein, occupational personnel must receive written and/or verbal information and training. Transient individuals are currently afforded temporary access to controlled areas where only occupational personnel may normally enter, provided they are made aware of their potential for exposure.³⁰⁶ In the *Order*, we clarify this awareness through requiring written and/or verbal information to be presented to these transient individuals.³⁰⁷ Here we further propose to also require supervision of transient individuals by trained occupational personnel within the controlled area where the general population limit is exceeded.³⁰⁸ We clarify herein that transient individuals in a controlled area may be any individual who would normally be subject to the general population exposure limits in uncontrolled environments, including occupational personnel that have not received training. In the context of satisfying the requirement to present written and/or verbal information to transient individuals and occupational personnel within controlled environments, we also clarify here that written information may include signs, maps, or diagrams showing where exposure limits are exceeded, and verbal information may include prerecorded messages.

183. Averaging time is an intrinsic part of the existing exposure limits, and as such, our intent is that averaging time may be used whenever there is adequate control over time of exposure.³⁰⁹ As we

³⁰⁴ See OET Bulletin 65, Page 53, “In some cases, the time-averaging aspects of the exposure limits may be used by placing appropriate restrictions on occupancy in high-field areas. However, such restrictions are often not possible where continuous exposure of the public may occur. In general, time averaging of exposures is usually more practical in controlled situations where occupational exposure is the only issue.” Also see OET Bulletin 65, Supplement B, Page 12, “It is important to note that for general population/uncontrolled exposures it is usually not possible or practical to control access or otherwise limit exposure duration to the extent that averaging times can be applied. In those situations, it would normally be necessary to assume continuous exposure to RF fields that would be created by the on/off cycles of the radiating source.”

³⁰⁵ Our continuous *exposure limits* are the values listed in § 1.1310 in Appendix A and may not be exceeded over an indefinite period of time but may be exceeded over shorter definite time periods given consideration of time averaging, whether “source-based” or “behavior-based.” The continuous exposure limits are generally used to define the boundaries of controlled areas where “behavior-based” time averaging may be necessary. We generally refer to simply the “exposure limit,” when “behavior-based” time averaging is not considered. See paras. 112 and 183.

³⁰⁶ See Note 1 to Table 1 in 47 CFR § 1.1310.

³⁰⁷ See § 1.1310(e)(1) in Appendix A.

³⁰⁸ See § 1.1307(b)(2)(ii) in Appendix B.

³⁰⁹ See 47 CFR § 1.1310.

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have proposed here for transient exposure, where the general population limit is exceeded (but not the occupational limit) and adequate controls are in place, averaging time may be used to comply with the general population limit.³¹⁰ For example, a transient individual walking in a controlled area may be exposed above the general population limit in one location and below this limit in another location, but the average over any 30-minute time period should be compliant with the general population limit. We seek comment on all of these proposals to better define transient exposure conditions beyond what has already been adopted in the *Order* herein. Specifically, we solicit comment on the expected cost associated with requiring supervision of transient individuals, where licensees would benefit from compliance certainty. We encourage interested parties to comment on both the relative costs as well as the benefits of the proposed changes in this section, as well as those of alternative approaches.

2. Proximity Restriction and Disclosure Requirements for Fixed RF Sources

184. *Summary.* In response to comments received in this proceeding, we propose specific training, access restriction, and signage requirements for fixed transmitter sites considering recent standards activity working toward defining industrial RF safety programs. Following the lead of IEEE Std C95.7-2005, we propose to define categories which require different mitigation actions depending on the level of exposure in an area.

185. *Further Proposal.* In the course of this proceeding, we received comments urging further guidance and clarification on specific mitigating actions that are sufficient to control radiofrequency (RF) exposure to maintain compliance with the limits.³¹¹ Thus, we propose training, access restriction, and signage requirements for fixed transmitter sites considering recent standards activity working toward defining industrial RF safety programs. In particular, we use, in part, a combination of certain concepts, programs, specifications, and actions contained in IEEE Std C95.7-2005,³¹² IEEE Std C95.2-1999,³¹³ NCRP 2002 Letter Report,³¹⁴ and Chapter 2.4 of the NAB Engineering Handbook³¹⁵ in the derivation of our proposed rules. These documents include details, such as specification of types of signs and when certain signs are appropriate, proper usage of access restrictions, and subjects to be included in appropriate training programs depending on the anticipated level of exposure. The Commission realizes that rigid requirements may not be practical in all cases, but clear rules that can be followed where feasible can help avoid both inadvertent over-exposure and unnecessary public concern. To be specific as to how our proposals would be implemented, we provide example scenarios herein and seek comment on these issues.

³¹⁰ Such time averaging may be “source-based” or “behavior-based” in analogy with the occupational hygiene field, where source-based time averaging would be an engineering control and behavior-based time averaging would be an administrative control. Source-based time averaging is defined in terms of an inherent property, such as duty-cycle, of a transmitter, as long as the available maximum time-averaged power levels are used and does not depend on any specific action by the user. We define behavior-based time averaging where specific user behavior over time may be necessary to maintain compliance.

³¹¹ See RSI Educational Foundation Comments at 1-2, RF People LLC Comments at 2, Pinnacle Telecom Group, LLC Comments at 6-7, Hammett & Edison, Inc. Comments at 1-2 Southern Communications Services Reply Comments at 8.

³¹² Institute of Electrical and Electronics Engineers, *IEEE Recommended Practice for Radio Frequency Safety Programs, 3 kHz to 300 GHz*, C95.7-2005.

³¹³ Institute of Electrical and Electronics Engineers, *IEEE Standard for Radio-Frequency Energy and Current-Flow Symbols*, C95.2-1999.

³¹⁴ National Council on Radiation Protection and Measurements, *Letter Report on Wireless Telecommunications Radiofrequency Safety Issues for Building Owners and Managers*, Scientific Committee 89-6, December 20, 2002.

³¹⁵ National Association of Broadcasters Engineering Handbook, 10th Edition, Chapter 2.4.

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186. While IEEE Std C95.7-2005 is intended as a set of guidelines to avoid potentially hazardous exposures to RF sources and suggests that “other schemes may be equally effective,” we propose to develop a set of specific mandatory rules to establish accountability among licensees and operators of fixed transmitters authorized under our rules so as to protect occupational personnel and the general public from exposure above our limits. We note that fixed radio transmitters are no longer located only on towers or facilities such as utility poles. Radio transmitters and their antennas have been deployed in a wide variety of forms, often designed as trees, chimneys, or panels on a building for aesthetic reasons, and their presence therefore might not be obvious. We realize that each transmitter site is different and that a wide range of exposure environments may exist, and so we seek comment on how to simultaneously provide flexibility and certainty to licensees and site owners while at the same time ensuring enforceable compliance with our exposure limits.

187. IEEE Std C95.7-2005 and other technical references³¹⁶ discuss the potential for RF sources to interfere with medical or other devices at field levels lower than the Commission’s human exposure limits for the general population. Medical devices are regulated by the Food and Drug Administration (FDA). However, the Commission works with the FDA to address the potential for electromagnetic interference to the normal function of medical devices. Further, electro-explosive devices oversight and standards exist through the Occupational Safety and Health Administration (OSHA), Mine Safety and Health Administration (MSHA), and the National Fire Code (NFC). The Commission’s exposure rules are intended to limit exposure of humans, not devices, to a specified acceptable level of RF energy. Thus, the Commission is specifically not considering in its proposal portions of IEEE Std C95.7-2005 that involve compatibility with medical devices, implants, or electro-explosive devices.

188. Additionally, the Commission rules do not presently establish limits on induced body current, contact current, or contact voltage, and in ET Docket 03-137 did not consider whether to introduce limits on these quantities. Adoption of these aspects would be a change to our exposure limits, and thus considering them is outside of the scope of this *Further Notice*. However, we do consider these aspects in the *Inquiry* below.³¹⁷

189. IEEE Std C95.7-2005 offers one solution for implementing an RF safety program by classifying exposure locations into one of four categories and specifying appropriate RF safety program elements for each category.³¹⁸ Relating terminology of Commission exposure limits to this IEEE standard for the purpose of this discussion, the general term “action level” used in the IEEE standard should be considered equivalent to the Commission exposure limit for the general population in an uncontrolled environment;³¹⁹ similarly, the general term “exposure limit” used by the IEEE should be considered equivalent to the Commission exposure limit for occupational personnel in a controlled environment. We emphasize that the general population exposure limit is a legal limit enforced by the Commission and should not be considered as merely action guidance, nor does this proposal suggest any different exposure limit than those currently in effect. The proposed mitigation actions in this section are meant to supplement the exposure limits themselves by facilitating compliance with them.

190. We propose to adapt the four IEEE Std C95.7-2005 categories as follows: Category One – locations where operational characteristics of sources would not cause the exposure limit for the general population to be exceeded; Category Two – locations where the exposure limit for the general population would be exceeded but not the exposure limit for occupational personnel; Category Three – locations

³¹⁶ AAMI TIR18:2010; IEEE Std C95.7-2005.

³¹⁷ See para. 205 *infra*.

³¹⁸ Note that exempt locations in relation to an RF source (see paras. 113 through 165 *supra herein*) or intrinsically compliant devices would fall into Category One. See also paras. 190 and 196 *infra*.

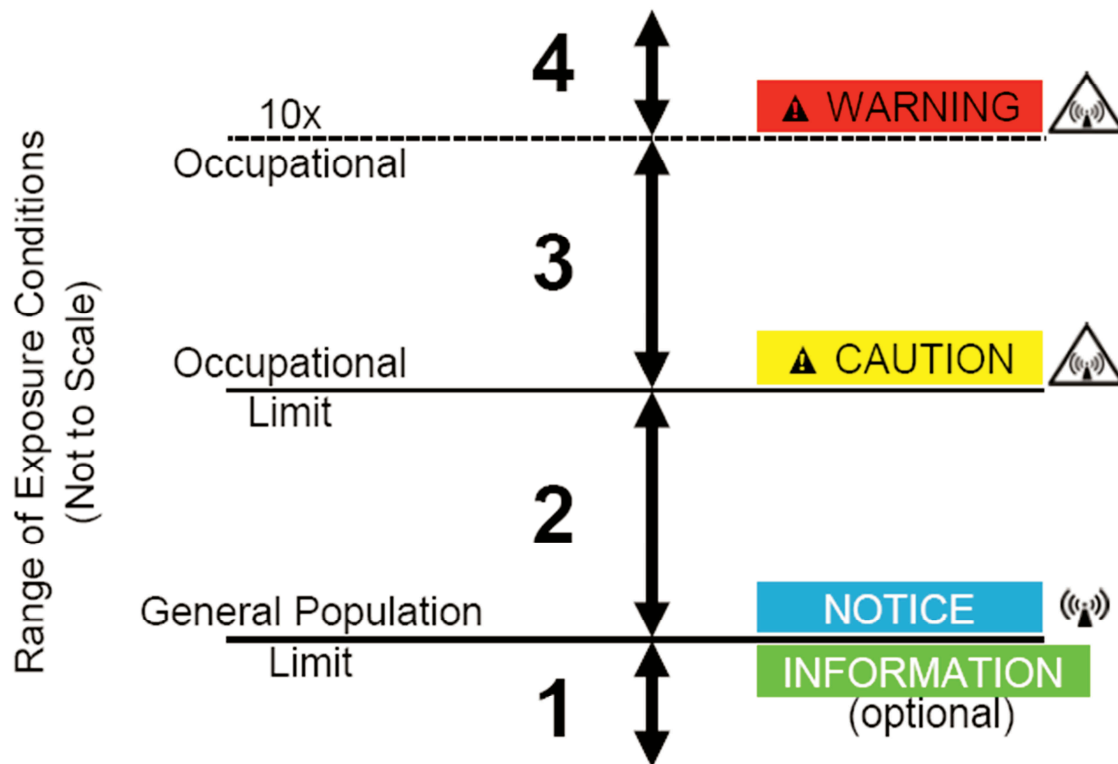
³¹⁹ See IEEE Std C95.7-2005, Section 1.3.

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where the exposure limit for occupational personnel would be exceeded and has the potential to exceed this limit by up to a factor of ten; Category Four – locations where the exposure limit for occupational personnel would be exceeded by at least a factor of ten or where there is a possibility for serious contact injury such as a severe burn, permanent tissue damage, or electrocution. For a visual depiction of these proposed categories and a general summary of the corresponding signage symbology, refer to Figure 1 below, adapted from IEEE Standards C95.7-2005 and C95.2-1999, since these categories have been amended slightly from their definition in IEEE Std C95.7-2005 to establish clearly enforceable boundaries. As further elaborated in our proposal, we seek to unambiguously define boundaries between each category based on the maximum time-averaged power over the appropriate time averaging period (six minutes for occupational or 30 minutes for general population). We seek comment on our proposed mitigation requirements. Specifically, we request comment on anticipated costs related to implementing this proposal for clear definition of compliance boundaries, given that most sites already likely comply with these proposed requirements, and we intend to allow sufficient time for licensees to inspect each of their sites for compliance if there may be any uncertainty.

Figure 1. Graphical Representation of Exposure Categories and Associated Signage Requirements



NOTE: Where immediate and serious injury would occur on contact regardless of category,

DANGER  is required pursuant to the description of Category Four below.³²⁰

Adapted from IEEE Std C95.7-2005 and IEEE Std C95.2-1999.

³²⁰ See para. 196 *infra*.

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191. We propose that the determination of the appropriate category should not be based on proposed or existing exemption from routine evaluation³²¹ but instead by an accurate evaluation, consistent with our existing recommendations and rules for routine evaluation of compliance by measurement or computation.³²² Such methods as spatial averaging of equivalent power-density, source-based time averaging, and specific absorption rate (SAR) determinations may be continue to be utilized where appropriate to determine compliance with an applicable limit and/or classification of the environment into one of the four proposed categories. We seek comment on how potential equipment failures or non-routine or auxiliary operation that may cause exposure over our limits should be considered in the determination of these categories. For example, for high-power fixed licensed operations, we presently require licensees to reduce power or cease operation as necessary to comply with exposure limits for persons having access to the site (including the tower, transmitter, transmission lines, and antenna)

192. We again emphasize that the general population exposure limit for uncontrolled environments is a definite legal limit enforced by the Commission. We propose that the establishment of a controlled environment where this limit is exceeded (*i.e.*, a Category Two, Three, or Four environment) would generally require some type of “positive restriction on access”³²³ (referred to herein as *positive access control*)³²⁴ and members of the general public should not be expected to be aware of or act on posted exposure conditions. We agree with the IEEE Std C95.7-2005 standard that Category One should not include “situations in which compliance with the applicable exposure limit requires some action by the exposed person, such as limiting the amount of time spent in certain locations.”³²⁵ IEEE’s guidance that “physical barriers” are optional for Categories Two and Three appears to be inconsistent with maintaining a controlled environment and with existing Commission policy.³²⁶ Consider for example the case offered by IEEE of a location where signs have been placed where the exposure limit for the general population is exceeded and a visually impaired person enters this area. Signs alone would not likely provide an effective control to keep this particular member of the general public from exposure above the limit. Other examples are readily apparent, such as access by non-English speakers and children, who may not necessarily be fully aware of conditions necessary to avoid exposure through the use of signs alone. We have in the past allowed only signage without the use of barriers “in a remote area not likely to be visited by the public.”³²⁷ Similarly, the IEEE suggests that signs alone are sufficient in remote areas.³²⁸ The question becomes one of determining whether an area can be considered “remote.” Evidence of public access, such as litter and trails, has been used by the Commission in past inspections to show that

³²¹ See paras. 121, 130, and 151 *supra*.

³²² OET Bulletin 65, Edition 97-01, August 1997.

³²³ See IEEE Std C95.7-2005, definition 3.1.22.

³²⁴ *Positive access control* includes locked doors, ladder cages, or effective fences, as well as enforced prohibition of public access to external surfaces of buildings, or generally, active preclusion of unauthorized access. However, it may not include natural barriers which tend to limit access but may not be effective or other access restrictions that did not require any action on the part of the licensee or property management.

³²⁵ See IEEE Std C95.7-2005, Section 1.3.

³²⁶ Appendix B of OET Bulletin 65, “Summary of 1986 Mass Media Bureau Public Notice on RF Compliance.”

³²⁷ In Situation B of Appendix B in OET Bulletin 65, there is an assumption “that there is no significant effect on the human environment with regard to exposure of the general public” if the non-compliant area is marked by appropriate warning signs and is “in a remote area not likely to be visited by the public.”

³²⁸ We use here the word “remote” specifically for the purpose of making a determination of compliance with respect to our radiofrequency exposure rules.

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an area is not “remote.”³²⁹ As an additional consideration, regions that are over the general population limit could coincide with locations not under the control of the responsible licensee; therefore easement for placement of fences and/or signs may not be feasible. Thus, we propose and seek comment on the feasibility of requiring positive access control for Category Two and the advisability of continuing the “remote” designation. The four proposed categories are discussed in further detail below.

193. Assignment of liabilities and level of cooperation between property owners, managers, licensees, and subcontractors may be an issue when implementing a site safety plan. Section 1.1307(b)(3) already requires “licensees whose transmitters produce, at the area in question, power density levels that exceed 5% of the power density exposure limit” to share in responsibility for compliance. We propose that this shared responsibility for compliance, elaborated in the *Order* herein *supra*,³³⁰ also include responsibility for mitigating actions. We seek comment on the extent of the responsibilities of licensees. For example, what actions should be required when a transmitting antenna located on top of a building generates fields in excess of our exposure limits at an elevated location on an adjacent property that is occasionally accessed by service personnel? We also note that our jurisdiction for determination of liability with respect to towers used for communications purposes is not necessarily limited to just licensees.³³¹ NCRP’s 2002 Letter Report emphasizes the need for building owners and managers to be involved in the implementation of an RF safety program. In its Appendices C and D, the NCRP’s 2002 Letter Report also offers examples of appropriate corporate policies, procedures, and lease language to aid compliance with our exposure limits. However, since it is ultimately the licensee that is responsible for compliance, we seek comment on how to better encourage cooperation between property owners, managers, and licensees in the implementation of RF safety programs.

194. The Commission maintains that accurate placement of appropriate signage is important and that such placement should make clear both where limits are exceeded and where limits are not exceeded. We have observed postings that imply that occupational limits are exceeded far outside areas that approach the general population limit. Such “over-signage” may result in undue alarm, confusion, and subsequent disregard of meaningful postings. According to IEEE Std C95.7-2005, “RF safety signs

³²⁹ See, e.g., *Notice of Apparent Liability for Forfeiture In The Matter Of Americom Las Vegas Limited Partnership Licensee of FM Radio Station KWNZ Carson City, Nevada, Facility ID # 53706*, DA 02-3218, November 22, 2002, 17 FCC Rcd 23689 at ¶ 15: “Americom asserted in its response to the May 1, 2002, LOI and the May 15, 2002, on-site inspection that the McClellan Peak site is remote. Americom also asserted that it has historically treated the areas at the McClellan Peak site which exceeded the public MPE limits as controlled areas subject to the occupational MPE limits. In support of these assertions, American submitted a statement from the Storey County Sheriff that his office receives little or no call volume relating to the site. However, we find that ample evidence exists that the site was publicly accessible and was in fact used by the public, including agent observations of the public driving ATVs at the site, a publicly accessible, commercially used road leading to the site, ungated and unfenced dirt paths to the tower locations, off-road ATV trails, ATV tire tracks, campfire rings, beer and wine bottles, and other trash at the site. We find that this evidence supports a conclusion that the areas were and could reasonably be expected to be used by the public. See also *Forfeiture Order In The Matter Of Americom Las Vegas Limited Partnership Licensee of FM Radio Station KWNZ Carson City, Nevada, Facility ID # 53706*, DA 04-1533, May 28, 2004, 19 FCC Rcd 9643; *Memorandum Opinion and Order In The Matter Of Americom Las Vegas Limited Partnership Licensee of FM Radio Station KZTQ (Formerly KWNZ) Carson City, Nevada, Facility ID # 53706*, FCC 06-174, December 1, 2006, 21 FCC Rcd 14286; and *Order on Reconsideration In The Matter Of Americom Las Vegas Limited Partnership Licensee of FM Radio Station KZTQ (Formerly KWNZ) Carson City, Nevada, Facility ID # 53706*, DA 07-4720, November 29, 2007, 22 FCC Rcd 20530.

³³⁰ See para. 80 *supra*.

³³¹ Section 503(b)(5) of the Communications Act of 1934, as amended (“Act”), 47 U.S.C. S: 503(b)(5), provides that forfeiture liability may be determined against any person if such person does not hold a license, permit, certificate, or other authorization issued by the Commission, if the person involved is a non-licensee tower owner who has previously received notice of the obligations imposed by Section 303(q) from the Commission or the permittee or licensee who uses that tower.

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should be installed before reaching the specific region of concern, but as close as practical, with an attempt to avoid demarcating unnecessarily large regions.”³³² Similarly, NCRP’s 2002 Letter Report states that “[i]nappropriate signage can raise unnecessary concerns.”³³³ Since each situation is different, we propose that those responsible for the placement of signs consider the potential implications of over-signage, and we will consider compliance with these proposed rules on a case-by-case basis. Unnecessary public concern may also arise from placement of a sign with an inappropriate signal word. For example, placement of a sign that says “DANGER” or “WARNING” in a location where RF fields may only approach the general population exposure limit might raise unnecessary alarm despite compliance in the area, since the words “danger” and “warning” imply conditions leading to imminent or likely physical harm.

195. IEEE Std C95.7-2005 states that “RF safety awareness training is normally the single most important aspect of controlling hazardous exposures to RF energy.”³³⁴ We agree that training is important, as discussed in the *Order*.³³⁵ Specifically with respect to requirements for appropriate training, we propose to consider the topics outlined in Annex A of IEEE Std C95.7-2005 as guidance to be referenced in a future revision of OET Bulletin 65. Regarding AT&T’s comment in response to the *Notice* in this proceeding seeking clarification on what constitutes verbal information,³³⁶ we propose that either spoken word or pre-recorded audio from an authorized individual qualified to provide such instructions on how to remain compliant would be acceptable. With respect to the allowance in IEEE Std C95.7-2005 of training to be optional for Category Two environments,³³⁷ we propose that such training is optional only for transient individuals who must be supervised, and training would be required for all other controlled situations in Category Two and higher categories consistent with the decision in the *Order*.³³⁸ Training may include effective web-based or similar programs.

196. We have used the environmental categories and guidance provided in IEEE Std C95.7-2005 to develop the following specific proposals that the categories below require the specified control actions:

- **Category One – INFORMATION** (Below General Population Exposure Limit):

No signs or positive access controls are proposed to be required; optionally a green “INFORMATION” sign may offer information to the public that a transmitting source of RF energy is nearby but that it is compliant with Commission exposure limits regardless of duration or usage. Labels or signs would not be required for fixed transmitters that can determine that the transmitter is “intrinsically compliant” with the general population exposure limit.³³⁹

³³² See IEEE Std C95.7-2005, Section 4.3.2.1.

³³³ See NCRP’s Letter Report, *op. cit.*, December 20, 2002, Section 2A-4.4.

³³⁴ See IEEE Std C95.7-2005, Section 4.5.

³³⁵ See para. 75 *supra*.

³³⁶ See AT&T comments at 1.

³³⁷ See IEEE Std C95.7-2005, *op. cit.*, Table 3, Section 4.5.

³³⁸ Since anyone in the general public could potentially be a transient individual in a controlled environment, our proposal would define these circumstances to be general population/“controlled” where the general population exposure limit must not be exceeded, accounting for appropriate time averaging in the controlled area such that overall exposure remains compliant with the continuous general population exposure limit; however, these transient individuals must not be exposed in any circumstance above the continuous occupational exposure limit without appropriate training. See para. 181 *supra*.

³³⁹ See para. 96 *supra*.

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- **Category Two – NOTICE** (Exceeds General Population Exposure Limit but Less Than the Occupational Exposure Limit):

Signs and positive access control are proposed to be required surrounding the areas in which the general population exposure limit is exceeded, with the appropriate signal word “NOTICE” and associated color (blue) on the sign. Signs must contain the content described below.³⁴⁰ However, we propose to allow under certain controlled conditions, such as on a rooftop with limited access (*e.g.*, a locked door with appropriate signage), “[a] label or small sign attached directly to the surface of an antenna ... if it specifies a minimum approach distance,”³⁴¹ to be sufficient signage. Allowing a label or sign to be affixed to an antenna is consistent with our policy for certain low-power fixed transmitters operating with a minimum separation distance more than 20 centimeters from the body of persons under normal operating conditions and with our decision in the *Order* of this proceeding regarding labeling requirements for fixed consumer subscriber antennas. Of course, a label affixed to an antenna would be considered sufficient only if it is legible at least at the separation distance required for compliance with the general population exposure limit in section 1.1310 of our rules. We propose appropriate training to be required for any occupational personnel with access to the controlled area where the general population exposure limit is exceeded, and transient individuals to be supervised by occupational personnel with appropriate training upon entering any of these areas. Use of time averaging would be required for transient individuals in the area in which the general population exposure limit is exceeded to ensure compliance with the time-averaged general population limit. Use of personal RF monitors in the areas in which the general population exposure limit is exceeded would be recommended but not required.

- **Category Three – CAUTION** (Exceeds Occupational Exposure Limit but by No More Than Ten Times):

In addition to the mitigation actions required within those areas designated as Category Two, additional signs (with the appropriate signal word “CAUTION” and associated color (yellow) on the signs), controls, or indicators (*e.g.*, chains, railings, contrasting paint, diagrams) are proposed to be required surrounding the area in which the exposure limit for occupational personnel in a controlled environment is exceeded. A label or small sign may be attached directly to the surface of an antenna within a controlled environment if it specifies a minimum approach distance where the occupational exposure limit is exceeded. We propose that transient individuals would not be permitted in any area in which the occupational exposure limit is exceeded. Additionally, appropriate training would be required for any occupational personnel with access to the controlled area where the general population exposure limit is exceeded. Use of personal RF monitors in the areas in which the general population exposure limit is exceeded is recommended but not proposed to be required. Use of personal protective gear (such as properly-worn RF protective suits) is recommended for occupational individuals in the areas in which the occupational exposure limit is exceeded.

- **Category Four – WARNING/DANGER** (Exceeds Ten Times Occupational Exposure Limit or Serious Contact Injury Possible):

In addition to the mitigation actions required within those areas designated as Category Three, “WARNING” signs with the associated color (orange) are proposed to be required where the occupational limit could be exceeded by a factor of ten, and “DANGER” signs with the associated color (red) are proposed to be required where immediate and serious injury will occur.³⁴² For example, “DANGER” signs would be required at the base of AM broadcast towers, where serious

³⁴⁰ See para. 200 *infra*.

³⁴¹ See IEEE Std C95.7-2005, Section 4.5.1.

³⁴² IEEE Std C95.7-2005 provides examples of the proper use of “DANGER” signs “as in the case of RF burns and/or RF electrical shocks.”

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injuries due to contact burns may occur. If power reduction would not sufficiently protect against the relevant exposure limit in the event of human presence considering the optional additional use of personal protective equipment, lockout/tagout procedures must be followed to ensure human safety.³⁴³

197. We note that barriers may not be appropriate in all situations for Category Two environments, and so we reiterate that we continue to support our suggested exceptions from Appendix B of OET Bulletin 65, Summary of 1986 Mass Media Bureau Public Notice on RF Compliance, to not require barriers where RF levels exceed the exposure limit in a remote area not likely to be visited by the public.³⁴⁴ Additionally, we recognize that there are certain routine circumstances, particularly near wireless base station antennas on the sides of buildings, where physical barriers may not be practical but third-party worker exposure may occur. Consideration of alternative control actions that may differ from these proposed rules may be appropriate, such as a posted sign on the exterior of such an antenna or positive access control.

198. The FCC Enforcement Bureau can initiate cases where it appears that RF exposure limits might be exceeded, and where non-compliance is found, the Bureau can require corrective action and impose fines or other sanctions. An example of a corrective action is an effective physical barrier such as enclosure of an area by a locked six-foot high chain-link fence or securing access to a rooftop by a locked door with signs posted to notify the public not to proceed because of the potential exposure to RF fields (applicable only where our exposure limits could be exceeded).³⁴⁵ However, besides an absence of signage,³⁴⁶ some other examples of where the Commission has declared existing control actions to be inadequate include: signs without contact information, signs placed incorrectly,³⁴⁷ improper types of signs, insufficient barriers,³⁴⁸ and unsecured entryways. We expect that these proposals throughout this section of the *Further Notice* will not create a significant new burden for transmitter site operators and licensees, since most high-power fixed licensees already implement RF safety programs, and much of this material is a codification of existing industry practice and standards. Nonetheless, we seek comment on this issue.

199. The Commission has maintained through its enforcement proceedings³⁴⁹ the importance of actions to control access to areas where the general population may be exposed to RF field levels in excess of its guidelines.³⁵⁰ Specifically, the Commission has made clear its intention to hold accountable fixed transmitter site licensees that fail to maintain an effective enclosure to prohibit public access to

³⁴³ According to the National Association of Broadcasters Engineering Handbook, 10th Edition, OSHA's "lockout/tagout" requirement (OSHA Regulations, Title 29 Code of Federal Regulations, § 1910.147) would require the appropriate transmitter to be shut down during the presence of occupational personnel. To prevent unexpected activation of the transmitter, "the circuit breaker feeding the transmitter should be locked (using a padlock) into the off position, and a warning tag placed to indicate that the transmitter may not be operated until the lock and tag are removed by the person who installed them."

³⁴⁴ See note 328 *supra*.

³⁴⁵ Forfeiture Order In The Matter of HTV/HTN/Hawaiian TV Network, Ltd., Licensee of Class A Television Station KHLU-LP Honolulu, Hawaii, Facility ID # 27969, DA 07-2138, May 24, 2007, 22 FCC Rcd 9241.

³⁴⁶ Forfeiture Order In The Matter of Entravision Holdings, LLC, Licensee of Station WVEA-LP Tampa, Florida Facility ID # 3602, DA 07-549, February 6, 2007, 22 FCC Rcd 2279.

³⁴⁷ Order on Review In The Matter of Infinity Broadcasting Corporation of Florida, Licensee of Station WQYK-FM Tampa, Florida Facility ID # 28619, FCC 09-27, April 7, 2009, 24 FCC Rcd 4270.

³⁴⁸ See footnote 352, *infra*.

³⁴⁹ See Forfeiture Order In the Matter of Real Life Broadcasting, Licensee of AM Station WIFI, Florence, New Jersey Facility ID # 55310, DA-09-1991, Released September 3, 2009.

³⁵⁰ See footnote 326, *supra*.

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areas where RF fields may exceed our limit.³⁵¹ Natural barriers are sometimes cited as adequate to prevent public access, however neither our rules nor case law permit natural barriers to meet the requirement that access to AM broadcast towers be limited to prevent RF contact burns as specified in section 73.49.³⁵² While OET Bulletin 65 does not contain any reference to the height, type, or condition of fencing, it does provide guidance on the use of an effective fence to restrict access,³⁵³ and this is one method of complying with the exposure limits in section 1.1310 of our rules by avoiding exposure to the general public above our limits. Fences used to limit human exposure to RF field levels under section 1.1310 may also be used to meet the AM fencing requirements under section 73.49 of our rules, but only if such fences are considered “effective locked fences or other enclosures.”³⁵⁴ We propose that natural barriers should also not be considered acceptable to comply with section 1.1310 of our rules, unless specifically approved by the Commission on a case-by-case basis. As an example, a natural body of water would not provide an acceptable barrier along a shoreline.

200. We also propose to require the following in the content of the sign, adapted from Section 2.4 of the National Association of Broadcasters Engineering Handbook, 10th Edition. Specifically, RF exposure advisory signs are proposed to include at least the following components:

- Appropriate signal word and associated color in accord with IEEE Std C95.2-1999 (*e.g.*, “DANGER,” “WARNING,” “CAUTION,” or “NOTICE”)
- RF energy advisory symbol (Figure A.3 of C95.2-1999)
- An explanation of the RF source (*e.g.*, transmitting antennas)
- Behavior necessary to comply with the exposure limits (*e.g.*, do not climb tower while antennas are energized)
- Contact information (*e.g.*, phone number or email address resulting in a timely response)

201. The discussion herein clarifies our proposals with respect to appropriate signal word use and appropriate explanations and methods for avoiding RF exposure in excess of our limits, while prior enforcement action justifies the need for including contact information in proposed sign content.³⁵⁵ We seek comment on these proposed rules. We are particularly interested in information as to the implementation cost and effectiveness of any required signs or other mitigation actions. We also request views as to what would be a reasonable timeframe, for example one year, within which to require compliance at new or existing sites and how to weigh this against any risks to the public or workers.

³⁵¹ Notice of Apparent Liability for Forfeiture In The Matter Of Americom Las Vegas Limited Partnership Licensee of FM Radio Station KWNZ Carson City, Nevada, Facility ID # 53706, DA 02-3218, November 22, 2002, 17 FCC Rcd 23689.

³⁵² Forfeiture Order In the Matter of Pittman Broadcasting Services, LLC, Licensee of Broadcast Stations KAOK(AM), Lake Charles, Louisiana, and KAOK-FM, DeRidder, Louisiana, Covington, Louisiana, August 9, 2004, DA-04-2473, 19 FCC Rcd 15320.

³⁵³ OET Bulletin 65 at 11, 53, and Appendix B.

³⁵⁴ See 47 CFR § 73.49.

³⁵⁵ Order on Review In The Matter Of Infinity Broadcasting Corporation Of Florida Licensee of Station WQYK-FM Tampa, Florida Facility ID # 28619, 24 FCC Rcd 4270 (2009).

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202. For the optional information sign discussed in Category One above, we recommend that it include at least the following information:

- Appropriate signal word (e.g., “INFORMATION”) and associated color (green)
- An explanation of safety precaution
- Contact information
- Reminder to obey all postings and boundaries (if higher categories are nearby)

203. Note that the inclusion of the RF energy advisory symbol and directions on how to avoid a potential hazard are excluded from these recommendations on the optional “INFORMATION” sign, since inclusion of these aspects on a sign where the general public exposure limit is not exceeded may cause confusion or unnecessary public alarm. If, for example, a member of the general public proceeds past an information sign and continues toward a source of RF energy, only at the point where that individual approaches the general population exposure limit should there be information on how to remain in areas where RF field levels are less than the public limit. Once this individual approaches the boundary where the general population exposure limit is exceeded, then the “NOTICE” sign would explain how to avoid exceeding the limits and positive access control would keep the individual from doing so. The use of language(s) other than English on an “INFORMATION” sign would be particularly advisable since the information sign would not include the universal RF energy symbol. We seek comment on these proposals. We encourage interested parties to comment on the relative costs and benefits of the proposed changes in this section, as well as those of alternative approaches.

E. Review and Update All RF Safety Text in Parts 1 and 2 for Clarity and Consistency

204. Given the rather extensive changes we propose in this *Further Notice* and have already made in the *Order*, we take this opportunity to propose a careful rewording of some of our rules in sections 1.1307(b), 1.1310, 2.1091, and 2.1093 as necessary to ensure clarity and consistency. We caution that a thorough examination of these proposed changes, provided in Appendix B, may be necessary. Changes to specific sections of Parts 15, 24, 25, 95, and 97 are necessarily dependent on our proposed changes in Parts 1 and 2. Since we propose that our general exemption criteria apply to all rule parts authorizing RF sources, specific exceptions in rule parts other than in Parts 1 and 2 are not necessary. We propose to substitute our general exemption criteria for the exclusion from routine evaluation of television band devices (TVBDs) based on power and distance in section 15.709(d); we propose to delete the references to IEEE Std C95.1-1991 and IEEE Std C95.3-1991 in section 24.51(c) and substitute our general exemption criteria for the exclusion from routine evaluation in section 24.52; we propose to remove the five percent criterion for earth station licensees in section 25.117(g) and introduce similar language to section 25.115, paragraph (j), section 25.129, paragraph (c), section 25.149, paragraph (c)(3), and section 25.226, paragraph (b)(8); we propose to substitute our general exemption criteria for the exclusion from routine evaluation in section 27.52, section 73.404, paragraph (e)(10), and section 90.1217; we propose to correct paragraph references in section 95.628(g); we propose to substitute our general exemption criteria for the exclusion from routine evaluation of amateur radio licensees based on power alone in section 97.13(c)(1); and we propose to substitute our general exemption criteria for the exclusion from routine evaluation of the Multichannel Video Distribution and Data Service (MVDDS) stations in the 12.2–12.7 GHz frequency band with output powers less than 1640 watts EIRP in section 101.1425. We seek comment on this proposal. We invite commenters to recommend similar types of corrective and conforming revisions to the Commission’s rules as alternatives to what we propose herein. We encourage interested parties to comment on the relative costs and benefits of all of these proposed changes, as well as those of any alternative approaches.

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V. NOTICE OF INQUIRY

A. Introduction

205. The first Commission *Notice of Inquiry* (1979 *Inquiry*) on the subject of biological effects of radiofrequency radiation occurred in 1979 in response to the need for the Commission to implement the National Environmental Policy Act (NEPA) of 1969.³⁵⁶ The most recent proceeding inviting comment on exposure limits was initiated in 1993 and culminated in a Report and Order in 1996, which resulted in our present limits. The instant rulemaking that is underway, initiated with the 2003 *Notice*, specifically excludes consideration of the exposure limits themselves. We continue to have confidence in the current exposure limits, and note that more recent international standards have a similar basis. At the same time, given the fact that much time has passed since the Commission last sought comment on exposure limits, as a matter of good government, we wish to develop a current record by opening a new docket with this *Notice of Inquiry* (*Inquiry*).

206. We recognize that a great deal of scientific research has been completed in recent years and new research is currently underway, warranting a comprehensive examination of this and any other relevant information. Moreover, the ubiquity of device adoption as well as advancements in technology and developments in the international standards arena since establishing our present policies in 1996 warrant an inquiry to gather information to determine whether our general regulations and policies limiting human exposure to radiofrequency (RF) radiation are still appropriately drawn. We also note the recommendation of the United States Government Accountability Office (GAO) in a report for Congress that the Commission formally reassess its current RF energy exposure limit, including the effects on human health, and that it solicit the opinions of relevant health and safety agencies in deciding whether any change in the current RF energy exposure limit is appropriate.³⁵⁷

207. We also received comments that addressed our present exposure limits in response to the *Notice*, even though those comments were beyond the scope of that *Notice*.³⁵⁸ In addition, EMR Network petitioned for the Commission to initiate an inquiry to consider an amendment of our exposure limits in 2003.³⁵⁹ Since our *Notice* excluded discussion of our exposure limits, we exercised our discretion at that time to defer investigation of the propriety of our exposure limits, which was upheld in court in 2004.³⁶⁰ In this *Inquiry*, we seek comment on whether our limits should be more restrictive, less restrictive, or remain the same.

208. As long ago as the 1979 *Inquiry* we sought to gather information “in light of the increased concern about the biological effects of radio frequency radiation.”³⁶¹ At that time, just as is

³⁵⁶ See 42 U.S.C. § 4321.

³⁵⁷ United States Government Accountability Office, Report to Congressional Requesters, *TELECOMMUNICATIONS: Exposure and Testing for Mobile Phones Should Be Reassessed*, GAO-12-771 (July 2012).

³⁵⁸ See The EMR Network comments at 1; Roger J. Mattson comments at 1; The EMR Policy Institute comments at 4; Margaret A. Brown comments at 1; Niels Kuster comments at 11, 12; Richard A. Tell reply comments at 10, 11; Hatfield and Dawson Consulting Engineers, LLC reply comments at 2.

³⁵⁹ 18 FCC Rcd 16822, 16827, ¶ 12 (2003).

³⁶⁰ See *EMR Network v. FCC*, 391 F.3d 269 (D.C. Cir. 2004).

³⁶¹ *Notice of Inquiry*, “In the Matter of Responsibility of the Federal Communications Commission to consider biological effects of radio frequency radiation when authorizing the use of radio frequency devices,” Gen. Docket No. 79-144, 72 FCC 2d 482 (1979).

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evident today,³⁶² there were “considerable differences of opinion about the biological effects of low level (*i.e.*, non-thermal or athermal) and long-term (chronic) exposure to RF radiation.”³⁶³ While we limited our scope of the 2003 *Notice* to implementation issues, we nonetheless received comments addressing a range of additional topics including induced and contact currents, dosimetry,³⁶⁴ and potentially adverse non-thermal biological effects.

209. In considering whether there is a need for changes to our RF exposure limit rules, our intent is to adequately protect the public without imposing an undue burden on industry. While acknowledging the potential difficulty of quantifying benefits and burdens in considering the overall costs of the regulation, we need to be mindful of our fundamental responsibility to provide for the appropriate protection of consumers, workers, and other members of the public. We therefore request comment, below, on a wide range of questions that will enable us to weigh those costs and benefits. We also request comment on the most cost-effective approach for modifying existing exposure limit policies and practices, if such modifications are needed, to achieve our goals. For each cost or benefit addressed, we ask that commenters provide specific data and information such as actual or estimated dollar figures, including a description of how the data or information was calculated or obtained and any supporting documentation. All comments will be considered and given appropriate weight. Vague or unsupported assertions regarding costs or benefits generally will receive less weight and be less persuasive than the more specific and supported statements.

210. Although the Commission is aware of recent scientific and technical standard publications, it is important to gather additional pertinent information and authoritative expert views to ensure we are meeting our regulatory responsibilities. Continued use of our present exposure limits is currently supported by statements from significant qualified expert organizations and governmental entities.³⁶⁵ But we specifically seek the opinions of federal agencies with jurisdiction by law or scientific expertise in this area as to the adequacy of our current RF exposure limits, in terms of safety and effects on human health and environmental effects. Some critics of our exposure limits have contrasting opinions, and we are aware of the general concerns raised some members of the public. The purpose of this *Inquiry* is to open a science-based examination of the efficacy, currency, and adequacy of the Commission’s exposure limits for RF electromagnetic fields. We underscore that in conducting this review we will work closely with and rely heavily – but not exclusively – on the guidance of other federal agencies with expertise in the health field. This approach will ensure that we will have fully discharged our regulatory responsibility and also will be appropriately responsive to the public’s interest in knowing that our RF exposure guidelines are based on the most current information, analysis, and expertise available.

B. Background

211. The Commission is required to evaluate its actions for possible significant impact on the environment³⁶⁶ and is also required to prescribe rules regarding the environmental effects of RF emissions.³⁶⁷ The Commission first adopted limits for public and worker exposure to RF fields in 1985³⁶⁸

³⁶² For contrasting examples of peer-reviewed published literature, see *Bioelectromagnetics*, Supplement 6, 2003 vs. *Pathophysiology*, Volume 16, Issues 2-3, 2009.

³⁶³ See 1979 *Inquiry*, Gen. Docket 79-144, 72 FCC 2d 482 (1979), at 1.

³⁶⁴ In the context of RF radiation, the term “dosimetry” is the determination of specific absorption rate (SAR) from exposure fields. For example, the MPE values are derived from whole-body SAR by dosimetric calculations.

³⁶⁵ National Council on Radiation Protection and Measurements, *Biological Effects of Modulated Radiofrequency Fields*, (NCRP commentary No. 18), December 2003.

³⁶⁶ National Environmental Policy Act of 1969. 42 U.S.C. § 4321 *et seq.*

³⁶⁷ See footnote 176, *supra*.

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and updated those limits in 1996³⁶⁹ based on exposure criteria published by the National Council on Radiation Protection and Measurements (NCRP)³⁷⁰ and an exposure standard published by the American National Standards Institute (ANSI) and the Institute of Electrical and Electronic Engineers, Inc. (IEEE).³⁷¹ Since the Commission is not a health and safety agency itself, adoption of these exposure criteria for human exposure to RF electromagnetic fields followed recommendations received from the U.S. Environmental Protection Agency (EPA), the Food and Drug Administration (FDA), and other federal health and safety agencies.

212. The Commission's rules include two types of guidelines limiting exposure to RF energy: specific absorption rate (SAR) and maximum permissible exposure (MPE).³⁷² For portable transmitting devices held close to the body such as cell phones, we enforce a limit on the localized SAR, which is a measure of the RF power absorbed inside a small part of the body. For transmitters and antennas located relatively far from the body, such as broadcast stations, cellular base stations, and two-way mobile vehicular radios, the MPE limits apply to the environmental level of RF field strength (energy) or power density (illumination) without the body present. At frequencies up to 6 GHz the MPE values are derived from the whole-body average SAR limits. As discussed in the *Order* herein,³⁷³ SAR is the primary metric for compliance with regard to exposure to RF energy, applicable to all transmitters operating from 100 kHz to 6 GHz. The MPE limit on power density is the primary metric from 6 to 100 GHz.³⁷⁴

213. The International Commission on Non-Ionizing Radiation Protection (ICNIRP) published exposure guidelines in 1998,³⁷⁵ and the IEEE published a major revision to its RF exposure standard in 2006.³⁷⁶ Every IEEE standard is subjected to review at least once every five years for revision or reaffirmation, so either a new revision of IEEE Std C95.1 or a reaffirmation of the latest version is expected in the near future. Having already released its latest guidelines on low frequency fields in

(Continued from previous page)

³⁶⁸ See *1979 Inquiry*, Gen. Docket 79-144, 72 FCC 2d 482 (1979).

³⁶⁹ *Report and Order*, ET Docket 93-62, 11 FCC Rcd 15123 (1996).

³⁷⁰ National Council on Radiation Protection and Measurements (NCRP), *Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields*, NCRP Report No. 86, Sections 17.4.1, 17.4.1.1, 17.4.2, 17.4.3 and 17.4.5, copyright 1986 by NCRP, Bethesda, Maryland 20814. The National Council on Radiation Protection and Measurements is a nonprofit corporation chartered by Congress in 1964 primarily to collect, analyze, develop, and disseminate information on radiation protection.

³⁷¹ American National Standards Institute (ANSI), *IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*, ANSI/IEEE Std C95.1-1992, Sections 4.1 and 4.2, copyright 1991 by the Institute of Electrical and Electronics Engineers, Inc. (IEEE), New York, New York 10017. IEEE is a non-profit international professional association of electrical and electronics engineers involved in technology standards development. ANSI is a private, not-for-profit organization that oversees its members and constituents throughout the process of standards development.

³⁷² 47 CFR § 1.1310.

³⁷³ *Report and Order*, in ET Docket 03-137.

³⁷⁴ The *1979 Inquiry* opened discussion of RF exposure limits over the 0 to 300 GHz frequency range, but the limits eventually adopted include frequencies between 100 kHz and 100 GHz.

³⁷⁵ International Commission on Non-Ionizing Radiation Protection (ICNIRP), *Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (Up to 300 GHz)*, Health Physics 74 (4): 494-522, 1998. ICNIRP is an international non-profit-making body of independent scientific experts addressing the possibility of adverse effects on human health of exposure to non-ionizing radiation.

³⁷⁶ Institute of Electrical and Electronics Engineers, Inc. (IEEE), *IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*, IEEE Std C95.1-2005, copyright 2006 by the Institute of Electrical and Electronics Engineers, Inc. (IEEE), New York, New York 10016-5997.

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2010,³⁷⁷ we anticipate that ICNIRP may also release a revision of its RF standard in the near future, and we invite parties to comment on this standard if it is released during the comment period established for this *Inquiry*. These more recent international exposure standards activities have a fundamentally similar basis in protecting against established adverse health effects due to tissue heating. It is noteworthy that both IEEE and ICNIRP localized SAR limits are 2.0 W/kg averaged over 10 grams as opposed to our existing localized SAR limit of 1.6 W/kg averaged over 1 gram. Thus, our SAR limits for devices held close to the body are somewhat more restrictive than other more recently adopted international SAR limits.³⁷⁸ However, we also note that our MPE limits – for more distant transmitters – are slightly less restrictive than those specified by ICNIRP at some frequencies.³⁷⁹ We seek to examine the bases for these determinations by other qualified and responsible expert bodies and ensure that there is a justification for our differing conclusions or adjust those conclusions accordingly.

214. As stated previously, our exposure limits are based in part on NCRP's exposure criteria from 1986. Although NCRP has not updated its criteria since its release, it did subsequently comment in 2002 that:

“[a]vailable evidence and research to date indicate that adherence to the FCC guidelines will avoid adverse effects of RF exposure on the nervous system and animal behavior, effects on vision and the neuroendocrine system, cardiovascular and hematological effects, and immune system effects. Similarly, the available evidence indicates that exposure to RF fields at levels in compliance with FCC guidelines does not lead to additional risk for cancer or adverse effects on potentially sensitive tissues involved in reproduction, embryonic development, and post-natal development.”³⁸⁰

NCRP went on to state that:

“[r]ecent reviews of the epidemiological literature, including extensive studies on humans exposed to modulated RF signals from wireless telecommunication systems, do not indicate that exposure to these fields leads to carcinogenic effects... Based on the body of current evidence from laboratory and human studies on the biological effects of modulated RF fields, there is no firm basis on which to modify the current FCC guidelines to make them more stringent.”³⁸¹

In the event that the Commission may propose to adopt new exposure limits in this proceeding, we seek comment on the preference, costs, and benefits of adopting any of the present or future standards being developed by IEEE, ICNIRP, or possibly by NCRP, keeping in mind the potential for international harmonization, the adequacy of supporting documentation, the differences in process and openness in development, and the technical completeness of each standard. Notwithstanding the above, we generally

³⁷⁷ International Commission on Non-Ionizing Radiation Protection (ICNIRP), *Guidelines for Limiting Exposure to time-Varying Electric and Magnetic Fields (1 Hz - 100 kHz)*, Health Physics 99(6): 818-836, 2010.

³⁷⁸ A larger averaging volume of similar shape would permit a higher spatial peak field in a small area of that mass, as there is more non-peak-exposed mass considered in the averaging. Therefore, the spatial peak exposure in a 10-gram cube could be more than the spatial peak exposure in a 1-gram cube for the same averaged SAR value. See para. 220 *infra*, where we request comment on whether there may be significant differences between using an averaging mass of 10 grams over a contiguous layer of tissue (*viz.* ICNIRP) versus an averaging mass of a 1-gram cube (*viz.* our existing localized SAR limit).

³⁷⁹ See paras. 220-230 *infra* for a more comprehensive discussion of the specific differences and potential shortcomings of each of these international standards.

³⁸⁰ National Council on Radiation Protection and Measurements (NCRP), *Letter Report on Wireless Telecommunications Radiofrequency Safety Issues for Building Owners and Managers*, (2002 Letter Report), Scientific Committee 89-6, December 20, 2002.

³⁸¹ *Id.* at 11.

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invite comment on any other present or future standards that the Commission should consider but which may not specifically be mentioned herein.

215. As already noted, the Commission is guided by the expertise of federal safety, health, and environmental agencies and institutes that, subject to any budgetary constraints, perform regular reviews of scientific research and periodically recommend any appropriate changes to, or reaffirm the validity of, the Commission's exposure criteria. Nonetheless, the Commission is confident of its own ability to remain abreast of scientific developments and research, and to participate in standards development and implementation, as is necessary to make an independent determination as to the adequacy of its exposure limits in the absence of affirmative input from agencies with more health and safety expertise. Because the Commission does not claim expertise as a *de facto* health agency, it necessarily considers the views of federal health and safety agencies and institutes that continue to address RF exposure issues³⁸² in formulating such judgments. We note that the international community has been active in this area, with the World Health Organization (WHO) initiating its electromagnetic fields (EMF)³⁸³ program in 1996³⁸⁴ and continuing its broad efforts in this area. As we continue to monitor such activity and information, we seek comment on the appropriate consideration of the evaluations of research conducted by international organizations or by activities in other countries. Moreover, we seek comment from federal agencies and institutes as to whether there may be any additional information or resources that could be provided by the Commission to support their ongoing activities.

C. Discussion

216. Although we continue to have confidence in our exposure limits, which are fundamentally similar to more recent standards activity, we nonetheless seek comment on whether we should consider any alternative limits, based on all currently available reliable and pertinent research and in light of the increase in numbers and usage of fixed transmitters and portable and mobile devices, as well as changes in usage and consequent exposure patterns. As stated previously, this *Inquiry* is intended to open a discussion on the propriety of the Commission's exposure limits and policies pertaining to RF exposure, relying on the guidance of other expert federal health and safety agencies and institutes.

217. In the first section below, which considers the general exposure limits *per se*, we request analyses of technical differences that have been raised in more recent standards-setting activities and ongoing research, such as: partial-body and whole-body averaging of exposure, averaging time, averaging area, peak pulsed RF fields, contact currents, frequency range, and conductive implanted objects. In the second section, we solicit comment on how to better provide information to consumers and the public about RF exposure. In the third section, on approaches to controlling RF exposure, we seek comment on the contrasting use of conventional exposure limits versus other precautionary measures and differences in current worldwide implementations of these philosophies. In the fourth section – which addresses evaluation issues – we ask about how the process developing our evaluation procedures might be improved. Finally, the last section, also related to evaluation, we seek comment on our current portable device separation distance policy when determining compliance.

³⁸² See, e.g., http://www.niehs.nih.gov/health/assets/docs_a_e/cell-phone-june-2011.pdf, <http://www.fda.gov/medicaldevices/newsevents/workshopsconferences/ucm199103.htm>, and <http://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/HomeBusinessandEntertainment/CellPhones/ucm116340.htm>.

³⁸³ In the context of the WHO, EMF encompasses the frequency range of 0 to 300 GHz, including extremely low frequency (ELF) fields.

³⁸⁴ See http://www.who.int/peh-emf/project/EMF_Project/en/index.html.

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1. Exposure Limits

218. *Introduction.* As discussed above, since we adopted our exposure limits in 1996, ICNIRP has developed guidelines (supported by the WHO), IEEE has revised its standard, and NCRP continued to support its criteria as used by the Commission. Similar to our present limits, the more recent limits are based on the avoidance of known adverse health effects. The adjustments underlying these newer limits are primarily due to significant developments in dosimetry. Also, several other exposure variables in the more recent standards more clearly specify various evaluation requirements, such as spatial averaging, spatial peak field limits, time averaging, overlapping frequency range for heating and shock effects, *etc.* While we recognize these developments, it is not clear that for the types of sources regulated by the Commission such details are essential beyond consideration in our non-regulatory informational materials (*i.e.*, Bulletins). While evaluation of compliance with our exposure limits appears at times to be increasingly more complex, because it is based on the straightforward restriction of time-averaged SAR up to 6 GHz, it can be well defined independently of advancements in technology. Nonetheless, this *Inquiry* will be helpful to establish whether the present limits are insufficiently protective, appropriately protective, or overly restrictive.

219. As an initial matter, while there has been increasing public discussion about the safety of wireless devices, to date organizations with expertise in the health field such as the FDA have not suggested that there is a basis for changing our standards or similar standards applied in other parts of the world. As stated above, our purpose in opening this proceeding is to provide a forum for a full and transparent discussion to determine whether any action may be appropriate. Accordingly, we ask generally whether our current standards should be modified in any way, notwithstanding the detailed discussion below. We specifically solicit information on the scientific basis for such changes as well as the advantages and disadvantages and the associated costs of doing so. In addition to seeking input from federal health and safety agencies and institutes, we solicit comment from national and international standards organizations (specifically including NCRP and IEEE) on the currency of their exposure limits and supporting documents in light of recent research and IARC's announcement on its classification of RF fields.³⁸⁵ We note that IARC's detailed monograph on this classification is not yet available, but may become available to inform our consideration during the course of this proceeding, and we invite parties to comment on this monograph if it is released during the comment period established for this *Inquiry*. Although IEEE Std 1528-2003, which we use to determine the compliance of devices such as cell phones intended to be used against the head, states that the mannequin in its measurement test setup "represents a conservative case for men, women, and children" alike,³⁸⁶ we specifically seek comment as to whether our current limits are appropriate as they relate to device use by children.³⁸⁷

220. *Partial-body and Whole-body averaging of exposure.* For localized SAR, both the ICNIRP and the newest IEEE standard limit exposure to 2.0 W/kg averaged over 10 grams of tissue as opposed to our existing localized SAR limit of 1.6 W/kg averaged over 1 gram. However, the definitions of the 10-gram averaging volume differ slightly between ICNIRP and IEEE. The ICNIRP guidelines specify an "averaging mass" over "any 10 g of contiguous tissue," while IEEE Standard C95.1-2005 specifies an averaging volume or mass over "any ten-grams of tissue in the shape of a cube." In contrast, for whole-body exposures in the frequency range between 100 kHz and 3 GHz, the ICNIRP and newest IEEE whole-body SAR limits, upon which MPEs are based in part, do not differ from our present

³⁸⁵ See IARC Classifies Radiofrequency Electromagnetic Fields as Possibly Carcinogenic to Humans, http://www.iarc.fr/en/media-centre/pr/2011/pdfs/pr208_E.pdf.

³⁸⁶ See IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques, IEEE Std 1528-2003.

³⁸⁷ See *Wireless Substitution: Early Release of Estimates From the National Health Interview Survey, January–June 2011*, Blumberg, S. and Luke, J., U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics, Figure 1, December 21, 2011.

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exposure limits. Our MPE limits, in conjunction with spatial averaging, should reasonably be expected to ensure compliance with the local SAR, whole-body SAR and power density limits.³⁸⁸ SAR provides a clear primary metric for compliance below 6 GHz. Power density is used as both a primary metric and MPE at higher frequencies above 6 GHz due to the shallow depth of penetration at these high frequencies. The purpose of using MPEs is to permit compliance measurements of more easily determined external fields without a body present. Depending on the exposure criteria used internationally, SAR would be the metric between 100 kHz and upper frequencies varying from 3 to 10 GHz (the exact upper limit depends on the particular exposure standard being applied), while power density is the metric at higher frequencies. Dosimetry is used to establish MPE values where SAR is primary. Thus, differences in MPEs between the standards are primarily due to variations in dosimetric modeling. We request comment on the significance, if any, of the differences between these standards. For example, we request comment on whether using an averaging mass of 10 grams over a contiguous layer of tissue would yield a significantly different SAR value than that averaged over a 1-gram cube and whether that difference would be consistently higher or lower, particularly with enough consistency to be able to establish a definable relationship between the measurement methods.

221. *Averaging Area.* The NCRP criteria and our regulations do not specify an averaging area for power density or a spatial maximum power density limit, while both the ICNIRP guidelines and the IEEE standards specify a spatial maximum power density, at least at higher frequencies (*e.g.*, between 3 and 10 GHz) of 20 times the whole-body MPE limit, generally averaged over 1 cm². In addition, IEEE Std C95.1-2005 specifies frequency-dependent averaging areas for power density above 3 GHz. As portable devices are developed for operation at higher frequencies, lack of clear definitions of spatial peak and spatially averaged power density in our limits may become more significant. We invite comment on whether we should change or clarify spatial averaging requirements and spatial maximum power density limits, at least at higher frequencies, either in our rules limiting human exposure to RF energy or in our non-mandatory materials. What are the advantages and disadvantages of any changes or clarifications, and would they be cost effective? More generally, we seek comment on whole-body spatial averaging techniques, particularly as applied to children at any frequency.³⁸⁹

222. *Averaging Time.* While different time averaging periods are defined in the various exposure standards, all use time averaging to demonstrate compliance with both SAR and MPE limits.³⁹⁰ These limits refer to a time-averaged SAR or power density, which may be determined over any interval equal to the time averaging period. This averaging time is sometimes misinterpreted to imply a limit on cumulative exposure over long time periods, which is not the case. None of these exposure standards considers exposure accumulation, since these standards are based on threshold thermal effects, where exposure below a threshold is assumed to cause no effect regardless of how long it lasts. Averaging time only affects compliance determination where there is power variation during intervals shorter than the time averaging period and does not affect application of the limits over longer time periods. Our exposure limits are intended for continuous exposure, that is, for indefinite time periods. The limits may be applied generally without time averaging, where the limits listed (typically in tables) would then be considered continuous exposure limits. While the averaging time for our exposure limits is six minutes for occupational and 30 minutes for general population exposure, the ICNIRP guidelines specify six minutes in both cases. IEEE Std C95.1-2005 specifies six minutes for occupational and 30 minutes for general population exposure at frequencies between 3 MHz and 3 GHz. We note that C95.1-2005 is more restrictive at lower and higher frequencies (*i.e.*, shorter time averaging periods are specified above and below those frequency limits). While the IEEE's shorter time averaging periods at higher frequencies are more restrictive for avoiding short-term surface heating effects, the ICNIRP guidelines are likely also

³⁸⁸ See para. 20 in the *Order* and Appendix H *infra*.

³⁸⁹ See Appendix H *infra*.

³⁹⁰ See para. 112 *supra*.

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effective in avoiding these effects due to more restrictive limits in power density at these frequencies. Below 3 MHz, our MPE limits, extracted from the 1986 NCRP criteria, could allow a higher short-term exposure for the general population than for a short-term occupational exposure of the same duration when accounting for averaging times. However, such scenarios are of limited practical importance given that such time averaging near fixed sources would not be applicable for the general population. Moreover, contact burns are the primary issue at such low frequencies and high fields, as discussed below.³⁹¹ We invite comment on whether we should modify our time averaging periods. If so, should we comport with recent standards activities? Alternatively from a precautionary perspective, should we consider any potential risk due to long-term exposure as relevant to our time averaging periods, and if so, what scientific evidence supports this?

223. In sections 2.1091(d)(2) and 2.1093(d)(5) of our existing rules, portable and mobile consumer devices may not use the 30-minute averaging time specified in section 1.1310. However, “source-based” time averaging may be used for these consumer products based on inherent transmission properties of a device. The rationale for restricting time averaging to “source-based” properties, provided in the 1996 *Report and Order*, was that “there is no control over usage of consumer devices,”³⁹² thus usage of a certain percentage of a 30-minute time interval for a device with, for example, push-to-talk capabilities could not guarantee that the device would not be used for the entire 30-minute period. Where the previous example would be an example of “behavior-based” time averaging,³⁹³ an example described in our existing rules where “source-based” time averaging is appropriate would be consideration of the inherent transmission duty-cycle in determining exposure from a device that employs a time-division multiple-access (TDMA) scheme. Other examples of “behavior-based” time averaging include increasing the separation distance between an RF device and the body, or maintaining a certain angle between an antenna and the body, such that the directional properties of the antenna are used to reduce exposure. These “behavior-based” actions involving portable or mobile consumer devices may not be realistic expectations for users in circumstances where the device is intended to be near the body and usage time is not necessarily limited. Since “source-based” averaging often involves consideration of transmit periodicity to determine the time interval over which to average at the maximum power achievable by the device, a 30-minute time averaging interval containing many identical periods at maximum power would result in the same average power as one period. For “source-based” time averaging the time period for evaluation is less than 30 minutes. Thus, if the periodicity of a device exceeds 30 minutes, then the largest “source-based” time averaging interval to be used for evaluation is 30 minutes. Notwithstanding our current policy, we request comment on whether consumers would prefer to be given an informed choice to behave in such a manner that may result in somewhat exceeding the exposure limits.

224. *Peak Pulsed RF Fields.* The present Commission rules do not include limits on peak pulsed RF fields, and independent standard-setting bodies have adopted differing standards applicable to such fields. The 1986 NCRP criteria state that “[t]he time averaging of and the limits on power densities and SARs as provided in the criteria in this report preclude circumstances in which excessive instantaneous peak power levels can occur. There is, therefore, no need to specify a limit on peak power, as such.”³⁹⁴ However, these criteria also state that “[b]ecause limited data are available to establish the relation between the biological effects of CW and pulsed sources,”³⁹⁵ it is necessary to employ time averaging to ensure compliance. The ICNIRP guidelines agree that “little information is available on the

³⁹¹ See para. 225 *infra*.

³⁹² *Report and Order* in ET Docket 93-62 (Guidelines for Evaluating the Environmental Effects of Radio frequency Radiation), 11 FCC Rcd 15123 (1996).

³⁹³ See, e.g., para. 181 *supra*, for an analogy of “behavior-based” time averaging to fixed RF sources.

³⁹⁴ NCRP Report No. 86, Section 17.4.8.

³⁹⁵ NCRP Report No. 86, Section 17.4.1.

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relation between biological effects and peak values of pulsed fields,” but it nonetheless set peak limits for the general public with an electric (E) field of approximately 130 volts per meter (V/m) at 100 kHz as its most restrictive reference level and a power density of 10,000 watts per square meter (W/m^2) “as averaged over the pulse width” from 2 to 300 GHz as its least restrictive reference level.³⁹⁶ The IEEE Std C95.1-2005 states that “[f]or exposures to pulsed RF fields in the range of 100 kHz to 300 GHz, the peak (temporal) value of the MPE for the instantaneous peak E field is 100,000 V/m [power density $\sim 18,800,000 \text{ W/m}^2$ averaged over a square pulse].”³⁹⁷ However, IEEE has taken the approach of limiting specific absorption by using variable averaging times to deal with short-term exposure. Clearly, there is a lack of harmonization among these standards due to limited information about the biological effects of peak pulsed fields. We request comment on whether we should adopt peak pulsed field limits for RF sources regulated by the Commission and, if so, what limits, if any, would be appropriate considering the costs and benefits of various approaches to this issue, including the possibility of maintaining our existing limits.

225. *Contact Currents.* Contact currents can be a safety issue in the vicinity of AM broadcast facilities.³⁹⁸ According to the ICNIRP guidelines, “[i]n the frequency range of about 100 kHz–110 MHz, shocks and burns can result either from an individual touching an ungrounded metal object that has acquired a charge in a field or from contact between a charged individual and a grounded metal object.”³⁹⁹ Thus, the ICNIRP guidelines specify reference levels for contact and induced currents up to 110 MHz. RF fields create induced RF currents on electrically large metal structures in the vicinity of standard AM broadcast towers. Commission rules limit direct human exposure near AM towers to about 600 V/m. However, large elevated conductive objects that are not effectively grounded in fields as low as 10 to 20 V/m can cause an RF burn when touched. Situations involving potential RF burns are typically discovered at construction sites within 300 meters of an existing high-power AM broadcast antenna. RF burns have occurred at structures including cranes, water towers, bridges, metal roofs, steel support cables, inactive power lines, and ungrounded fences. We are not aware of similar hazards near other transmitters operated by Commission licensees aside from those used by AM stations. Considering the wavelengths necessary to induce significant currents on large objects, it is not expected that higher frequency RF sources would cause comparable problems, especially given the lack of complaints at these frequencies.

226. In the *Further Notice*, we have already proposed placement of “DANGER” signs where immediate and serious injury would occur, such as making contact with an AM broadcast tower that has a high RF voltage at its base.⁴⁰⁰ We note that contact RF burns do not always result in serious injury. RF burns due to induced currents may be minor (or associated with only a startle reaction) but are often

³⁹⁶ See International Commission on Non-Ionizing Radiation Protection (ICNIRP), *Guidelines for Limiting Exposure to time-Varying Electric and Magnetic Fields (1 Hz - 100 kHz)*, Health Physics 99(6): 818-836, 2010, Table 7, Notes 4 and 5, and Table 4, Note 3, “For frequencies up to 100 kHz, peak current density values can be obtained by multiplying the rms value by $\sqrt{2}$ (~ 1.414). For pulses of duration t_p , the equivalent frequency to apply in the basic restrictions should be calculated as $f = 1/(2t_p)$. Between 100 kHz and 10 MHz, peak values for the field strengths are obtained by interpolation from the 1.5-fold peak at 100 kHz to the 32-fold peak at 10 MHz. For frequencies exceeding 10 MHz it is suggested that the peak equivalent plane wave power density, as averaged over the pulse width does not exceed 1,000 times the S_{eq} restrictions, or that the field strength does not exceed 32 times the field strength exposure levels given in the table.”

³⁹⁷ IEEE Std C95.1-2005, Table 9, Note e.

³⁹⁸ See, e.g., OSHA Safety Hazard Information Bulletin on Radiofrequency Radiation-caused Burns, September 5, 1990, http://www.osha.gov/dts/hib/hib_data/hib19900905.html, which recognizes burns of this type, caused by AM radio, to be a “potentially serious hazard.”

³⁹⁹ See footnote 377 *supra*.

⁴⁰⁰ See para. 196 *supra*.

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unacceptable to workers, may delay construction projects, and may place unexpected burdens on the contractor who must navigate around an unfamiliar hazard. Here, we seek to expand upon our proposal in the *Further Notice* by requesting comment on the appropriate Commission's strategy to promote awareness for construction and maintenance project contractors and planners where the potential for contact RF burns, whether serious or minor, could occur. For example, would it be beneficial for the Commission to provide publicly available maps showing areas where electric fields exceed 10 V/m from AM broadcast stations? If so, we invite comment as to whether AM broadcast stations currently have this information and, if not, to explain the impact of collecting this information and making it available to the Commission. How much time should be required to do so and what would be the costs and benefits?

227. Generally, Commission involvement in RF contact burn cases has been limited to providing technical advice on mitigation strategies and emphasizing cooperation between the broadcaster and the affected person(s). Historically, the broadcaster and the affected party (usually a construction contractor) both have an interest in mitigation because, aside from the question of safety regarding contact RF burns, the radiation pattern of the AM broadcast station may be disturbed by nearby construction.⁴⁰¹ We note that only the field and not the burn hazard existed before a structure was placed in the field. It is neither the field nor the structure alone, but the combination of the two that causes the problem. The AM station may be a long-standing facility, while recent development has generated the construction nearby. We seek comment on whether the cost of dealing with this issue when it arises should be the responsibility of the station, the affected party, or both. We also seek comment as to whether the Commission is the appropriate body to address this issue.

228. In section 1.1310 of our rules, we state that our MPE limits are based in part on Section 4.1 of ANSI/IEEE Std C95.1-1992 (IEEE Std C95.1-1991), which includes not only field strength and power density limits, but also induced and contact current limits. The limits for induced and contact currents were updated in the latest IEEE Std C95.1-2005 between 3 kHz and 110 MHz, where induced current is limited to considering conditions (impedance) in the human body for both feet and one foot on the ground and contact current is divided into both grasp and touch contact to protect against RF shock and burn hazards. In addition to induced and contact current, IEEE Std C95.1-2005 also specifies a limit for contact voltage to protect against RF burns. We explicitly adopted only the field strength and power density limits of Section 4.1, opting not to include induced and contact current limits mainly due to the difficulty of measurement standardization at that time.⁴⁰² Specifically, in our 1996 *Report and Order* we stated that, "[a]lthough we are not adopting limits for induced and contact currents in this proceeding, we recognize the desirability for limits to be adopted in the future, particularly if more accurate measuring instruments become available. Accordingly, we will continue to monitor the issues raised in this proceeding with respect to induced and contact currents, and we may revisit this issue and issue a specific proposal for controlling such exposures."⁴⁰³ In addition, there are practical difficulties with routine evaluation of contact currents because of the unpredictable nature of interactions between fields and various structures in the environment. While contact burns are a universally recognized hazard of variable severity, adoption of numerical limits on contact RF currents over a broad frequency range may not be effective in avoiding situations where burns actually occur. We request comment on the feasibility, efficacy, and burden of contact current limits versus other, perhaps informational, approaches such as mapping.⁴⁰⁴

⁴⁰¹ See 47 CFR §§ 22.371, 27.63, and 73.1692.

⁴⁰² See *Report and Order* in ET Docket 93-62 (Guidelines for Evaluating the Environmental Effects of Radio frequency Radiation), 11 FCC Rcd 15123 (1996), paras. 130 through 151.

⁴⁰³ *Report and Order* in ET Docket 93-62 (Guidelines for Evaluating the Environmental Effects of Radio frequency Radiation), 11 FCC Rcd 15123 (1996).

⁴⁰⁴ See para. 226 *supra*.

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229. *Frequency Range.* The 1979 Inquiry⁴⁰⁵ opened discussion of exposure limits over the 0 to 300 GHz frequency range, but the limits eventually adopted in 1996 included only frequencies between 100 kHz and 100 GHz as this was the extent of the frequency scope of the standards we adopted and there were few sources of considerable significance outside of this scope at that time.⁴⁰⁶ The IEEE and ICNIRP guidelines also encompass the frequency range between 0 and 300 GHz. Given that this Inquiry, analogous to the prior 1979 Inquiry, considers exposure from RF sources included in the frequency range from 0 to 300 GHz, we request comment on whether, in addition to the limits already established for RF fields between 100 kHz and 100 GHz, we should also explore actions to control exposure outside of this frequency range (e.g., in the range between 0 and 100 kHz and/or 100 and 300 GHz) due to sources authorized by the Commission. We note that some wireless inductive chargers operate at frequencies below our current frequency scope, and all terahertz (THz) sources operate at frequencies above our current frequency scope. We also request comment on whether explicitly controlling exposure in these additional frequency ranges may have a broader impact on or be in conflict with our rules and what the relative costs and benefits would be. Currently, our frequency range is applied through the use of SAR between 100 kHz and 6 GHz and MPE between 300 kHz and 100 GHz. We note that below 100 kHz (for SAR) or below 300 kHz (for MPE), as well as above 100 GHz (for MPE), there are still general compliance obligations under sections 1.1307(c) and (d) for sources regulated by the Commission.

230. *Conductive Implanted Objects.* Electrically conductive objects in or on the body may interact with sources of RF energy in ways that are not easily predicted. Examples of conductive objects *in* the body include implanted metallic objects. Examples of conductive objects *on* the body include eyeglasses, jewelry, or metallic accessories. We seek comment on whether the present volume-averaged SAR limits are protective for the more localized SAR that may occur near the tip of a conductive object such as the end of an implanted wire. In general, we seek comment on whether high levels of RF exposure may cause internal thermal injury at the site of conductive implants.⁴⁰⁷ Commenters are specifically advised to provide scientific research or analysis to support their arguments and to propose practical and effective regulatory responses for any such assertion, and we seek comment on the costs and benefits of any such approach.

2. Consumer Information

231. The Commission has continually provided information to the general public regarding the potential hazards of radiofrequency electromagnetic fields.⁴⁰⁸ The information provided regarding RF safety includes the Commission's Office of Engineering and Technology (OET) Bulletins 56 and 65 (and their Supplements),⁴⁰⁹ the *Local Official's Guide*,⁴¹⁰ the Consumer and Governmental Affairs Bureau (CGB) Consumer Guides,⁴¹¹ and other information (including links to external resources) on our

⁴⁰⁵ See 1979 Inquiry, Gen. Docket 79-144, 72 FCC 2d 482 (1979).

⁴⁰⁶ See *United States Frequency Allocations: The Radio Spectrum*, U.S. Department of Commerce, National Telecommunications and Information Administration (NTIA) Office of Spectrum Management, October 2003. In particular, see the allocations between 9 kHz and 100 kHz.

⁴⁰⁷ See Virtanen, H., et. al., *Interaction of Radio Frequency Electromagnetic Fields and Passive Metallic Implants – A Brief Review*, Bioelectromagnetics, 27:431-439, 2006, and Crouzier D, et. al., *Risk assessment of electromagnetic fields exposure with metallic orthopedic implants: A cadaveric study*, Journal of Orthopaedics & Traumatology: Surgery & Research, 25 Jan 2012 [Epub ahead of print].

⁴⁰⁸ See FCC OET Bulletin 56, *Questions and Answers about Biological Effects and Potential Hazards of Radiofrequency Electromagnetic Fields*, Fourth Edition, August 1999.

⁴⁰⁹ See <http://www.fcc.gov/oet/info/documents/bulletins/>.

⁴¹⁰ *A Local Government Official's Guide to Transmitting Antenna RF Emission Safety: Rules, Procedures, and Practical Guidance* (June 2, 2000) ("Local Official's Guide").

⁴¹¹ See http://www.fcc.gov/cgb/information_directory.html.

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website.⁴¹² OET Bulletin 56 was designed to answer general non-technical questions about biological effects of RF fields and explain our exposure limits, and OET Bulletin 65 is intended to be a technical document with supplements designed to provide practical guidance on determining compliance with the Commission's exposure limits. In contrast to the general information provided in OET Bulletin 56, CGB FCC Consumer Guides provide information on specific topics on which the Commission has received numerous inquiries, such as cellular base stations, mobile antennas, wireless devices, and specific absorption rate (SAR).⁴¹³ The *Local Official's Guide* provides a framework for local and state governments and wireless service providers to cooperate in the determination of compliance with the Commission's RF exposure limits. We request comment on what additional information should be provided to consumers and in what format to assist in making decisions about reducing exposure.⁴¹⁴ We also specifically seek comment on how we can ensure that such information is presented in formats that are accessible to people with disabilities.

232. We continue to receive inquiries on various subjects related to RF exposure, particularly as infrastructure is deployed to support new wireless technologies. Some of those inquirers perceive deployment of fixed transmitters to support a wireless network as an action that may affect them involuntarily (as opposed to use of a cell phone, which is a voluntary activity and exposure). For example, even though exposures generated by fixed wireless base stations (and fixed RF sources in general) are typically orders of magnitude less than those from cell phones and other portable devices (due to proximity), exposures due to fixed RF sources are both involuntary and long-term. However, even if continuous exposure is assumed from wireless base stations, the total energy absorbed from a nearby base station is typically much less on average than that due to using a cell phone. We seek comment on what additional information we should develop relating to exposures from common fixed sources.

233. Several general strategies are available for users of portable devices that want to reduce their exposure. While increasing distance from the device and decreasing time of use are obvious actions to reduce exposure, the benefits of other strategies are not immediately obvious and could be subject to significant research to determine whether they may be effective. For example, factors such as power control (e.g., the relationships of indicated signal level ("bars"), geographic location, and network technologies to SAR),⁴¹⁵ modulation, low frequency fields, headset use, texting instead of talking, device antenna location, etc., could all affect exposure, but whether exposure awareness and control of these factors can reduce exposure may depend on many variables. Some aftermarket products, such as small patches or shields,⁴¹⁶ whether conductive or not, could either have no effect on exposure or could affect exposure in an unpredictable manner, with the possibility of increasing exposure given certain conditions.⁴¹⁷

⁴¹² See <http://www.fcc.gov/oet/rfsafety/> and <http://www.fcc.gov/oet/rfsafety/rf-faqs.html#Q28>.

⁴¹³ See <http://www.fcc.gov/cgb/consumerfacts/mobilephone.html>.

⁴¹⁴ e.g., Switzerland's approach: <http://www.bag.admin.ch/themen/strahlung/00053/index.html?lang=en> and <http://www.bafu.admin.ch/publikationen/publikation/00686/index.html?lang=en>.

⁴¹⁵ See Journal of Exposure Science and Environmental Epidemiology, *Measured Radiofrequency Exposure During Various Mobile-Phone Use Scenarios*, Kelsh, M., et. al., pp. 1–12, 16 June 2010; doi:10.1038/jes.2010.12.

⁴¹⁶ See Bioelectromagnetics, *Testing the Effectiveness of Small Radiation Shields for Mobile Phones*, Oliver, J., et. al., 24:66 – 69, 2003. Also see Federal Trade Commission, *Listen Up: Tips to Help Avoid Cell Phone Radiation Scams*, <http://www.ftc.gov/bcp/edu/pubs/consumer/alerts/alt109.shtm>, September 2011.

⁴¹⁷ See Schweizerische Eidgenossenschaft, *Topics – Radiation, Radioactivity and Sound – Electromagnetic Fields – EMF Fact Sheets – Mobile Phones*, that states “[b]e wary of radiation shields and other such protective devices that are claimed to limit exposure to radiation. They may reduce the connection quality and therefore force the phone to transmit at a higher output power.” <http://www.bag.admin.ch/themen/strahlung/00053/00673/04265/index.html?lang=en>.

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234. The Consumers Union suggests that the Commission “mandate that the SAR information included with phones be more consistent.”⁴¹⁸ We agree that there is inconsistency in the supplemental information voluntarily provided in the manuals provided with portable and mobile devices. We also note that for a variety of reasons, the maximum SAR value that is normally supplied is not necessarily a reliable indicator of typical exposure and may not be useful for comparing different devices. For example, the SAR values are obtained based on the maximum power of the device, but the amount of time the device operates at maximum power may depend on the network and typical usage conditions. Furthermore, many devices today include multiple radios, each one of which has a different SAR rating, which could easily be confusing to consumers. Moreover, SAR varies with different phone positions, and so the same phone may result in varying levels of RF absorption depending on how the phone is used. We request comment on whether the Commission should consistently require either disclosure of the maximum SAR value or other more reliable exposure data in a standard format, perhaps in manuals, at point-of-sale, or on a website.

235. Information on the SAR of a particular device is available from the Commission’s website if an individual knows the FCC ID, which is printed on every device. We recognize that it is not always easy for some to access the SAR information, because the FCC ID is not tied to the model number or marketing name of the device, and there may be multiple records for each FCC ID, potentially creating confusion. Given that private organizations have already linked FCC IDs to device model numbers, we request comment on whether the Commission should also take actions that would better enable consumers to correlate the make and model number of their device to an FCC ID.⁴¹⁹ If so, how could this be accomplished and what would be the impact on industry? We request comment in general on the information discussed that would be most useful to provide precautionary guidance to consumers.⁴²⁰

3. Exposure Reduction Policies

236. The Commission has a responsibility to “provide a proper balance between the need to protect the public and workers from exposure to potentially harmful RF electromagnetic fields and the requirement that industry be allowed to provide telecommunications services to the public in the most efficient and practical manner possible.”⁴²¹ The intent of our exposure limits is to provide a cap that both protects the public based on scientific consensus and allows for efficient and practical implementation of wireless services. The present Commission exposure limit is a “bright-line rule.” That is, so long as exposure levels are below a specified limit value, there is no requirement to further reduce exposure. The limit is readily justified when it is based on known adverse health effects having a well-defined threshold, and the limit includes prudent additional safety factors (e.g., setting the limit significantly below the threshold where known adverse health effects may begin to occur). Our current RF exposure guidelines are an example of such regulation, including a significant “safety” factor, whereby the exposure 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. This “safety” factor can well accommodate a variety of variables such as different physical characteristics and individual sensitivities – and even the potential for exposures to occur in excess of our limits without posing a health hazard to humans.

237. Despite this conservative bright-line limit, there has been discussion of going even further to guard against the possibility of risks from non-thermal biological effects, even though such

⁴¹⁸ See Consumer Reports, *How Risky is Cell-Phone Radiation?*, p. 31, January 2011.

⁴¹⁹ See, e.g., <http://reviews.cnet.com/cell-phone-radiation-levels/>.

⁴²⁰ See para. 240 *infra*.

⁴²¹ *Second Memorandum Opinion and Order and Notice of Proposed Rule Making* in ET Docket 93-62, 12 FCC Rcd 13494 (1997), para. 2.

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risks have not been established by scientific research. As such, some parties have suggested measures of “prudent avoidance”⁴²² – undertaking only those avoidance activities which carry modest costs. For example, New Zealand has not set a specific precautionary environmental limit beyond its adoption of the ICNIRP guidelines, opting instead to minimize, “as appropriate, RF exposure which is unnecessary or incidental to achievement of service objectives or process requirements, provided that this can be readily achieved at modest expense.”⁴²³ However, the environmental exposure levels from fixed transmitters, such as broadcast facilities and cellular base stations, are normally not only far below the MPE limit, but also well below exposure from a portable device such as a cell phone. Thus, the adoption and enforcement of considerably more restrictive MPE limits might have little, or no, practical effect under most environmental exposure scenarios, but may significantly increase infrastructure costs which would ultimately be paid by consumers. Nonetheless, some countries have implemented extra “precautionary” environmental limits for fixed transmitters far below the prevailing scientifically-based values, sometimes limited to specific locations.⁴²⁴ The SAR limits for portable devices, however, have not been correspondingly reduced by these considerations because of various practical limitations on device design.

238. In this regard, we stress that while we must be cognizant of and considerate of other countries’ standards or agencies’ activities or recommendations, we would be guided by them only to the extent we would have confidence in the research, analysis, and principles upon which they are based, as well as the tangible benefits they would provide. Additionally, the concept of “prudent avoidance” encourages a balance between exposure reduction and cost. Imposing additional precautionary restrictions on device design and/or on the siting of fixed transmitting facilities to reduce exposure may entail significant costs that licensees and equipment manufacturers would need to consider when developing communications systems or designing equipment. Nevertheless, we note, some jurisdictions have adopted precautionary restrictions or comparable requirements. For example, the California Public Utilities Commission requires utility companies to allocate a small percentage of total project cost to ELF field exposure reduction actions during power line construction.⁴²⁵ We request comment on whether any general technical approach to reduce exposure below our limits in some situations is appropriate or feasible, particularly in cases in which there is no specific quantitative goal for improvement.

239. There are natural trade-offs that come into play when considering extra precautionary aspects of system design. For example, increased antenna height tends to reduce exposure levels nearby at ground level, but taller towers may increase cost, may possibly have a greater environmental impact,⁴²⁶

⁴²² See U.S. Congress, Office of Technology Assessment, *Biological Effects of Power Frequency Electric & Magnetic Fields—Background Paper*, OTA-BP-E-53, May 1989.

⁴²³ See Ministry for the Environment / Ministry of Health, New Zealand, *National Guidelines for Managing the Effects of Radiofrequency Transmitters*, Page 24, December 2000, <http://www.mfe.govt.nz/publications/rma/radio-freq-guidelines-dec00.html>.

⁴²⁴ As examples of precautionary environmental limits, according to <http://www.who.int/docstore/peh-emf/EMFStandards/who-0102/Worldmap5.htm>, Switzerland has “installation limit values” between 3 and 8.5 V/m; and Italy has “attention values” and “quality goals” of 6 V/m (according to a translation by Dr. Paolo Vecchia), which are more restrictive than ICNIRP guidelines (ICNIRP limits are as low as 28 V/m in the 10 to 400 MHz frequency range). India has recently (November 2011) set its base station exposure limit to 1/10th of ICNIRP guidelines. Additionally, Russia has a general public electric field strength limit down to 3 V/m (in the 30 to 300 MHz frequency range).

⁴²⁵ See California Public Utilities Commission, *Order Instituting Investigation on the Commission's Own Motion to Develop Policies and Procedures for Addressing the Potential Health Effects of Electric and Magnetic Fields of Utility Facilities*, Decision No. 93-11-013, Investigation No. 91-01-012, (Filed January 15, 1991), 1993 Cal. PUC LEXIS 844; 52 CPUC2d 1, November 2, 1993.

⁴²⁶ See Final Programmatic Environmental Assessment for the Antenna Structure Registration Program, released March 13, 2012, at 7-1, http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0313/DOC-312921A1.pdf (continued....)

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and may be inconsistent with community zoning goals.⁴²⁷ In addition, higher mounting of antennas could negatively impact system architecture, constraining the provision of service. Local efforts to avoid placement of fixed wireless base stations in particular areas can unintentionally result in increased exposure to users of portable devices within those areas where personal portable devices would transmit using greater power in order to communicate with distant base stations, thus increasing the RF emissions and consequent exposure from the device itself. Finally, distributed antenna systems (DAS) can offer more advanced services from multiple carriers with a single physical network of less visually intrusive lower profile antenna installations and may likely reduce exposure to device users, but we seek comment on whether such installations reduce or increase environmental exposures.

240. Given the complexity of the information on research regarding non-thermal biological effects, taking extra precautions in this area may fundamentally be qualitative and may not be well-served by the adoption of lower specific exposure limits without any known, underlying biological mechanism. Additionally, adoption of extra precautionary measures may have the unintended consequence of “opposition to progress and the refusal of innovation, ever greater bureaucracy,... [and] increased anxiety in the population.”⁴²⁸ Nevertheless, we invite comment as to whether precautionary measures may be appropriate for certain locations which would not affect the enforceability of our existing exposure limits, as well as any analytical justification for such measures. Parties advocating such measures should suggest specific situations in which more restrictive limits (and corresponding thresholds) or alternative requirements should be applied, and provide their scientific basis and substantive information as to the tangible benefits and corresponding costs. If such action were taken, we solicit views as to whether it should be applied only prospectively or also to existing situations, and if so, what would be the impact on existing systems in terms of costs and performance and what period of time should be afforded for compliance?

241. We seek comment on the possibility that there may be other precautionary measures not involving reduction of time-averaged SAR that could possibly reduce potential risk, without necessarily assuming that such risks are known. For example, such precautionary measures could include limitations on characteristics that have little or no impact on performance, such as ELF fields, peak pulsed RF fields, or modulation. We request comment on what aspects of extra precautionary measures could be effective, what aspects may be counterproductive or unnecessary, and what other extra precautionary measures could be efficiently and practically implemented at modest cost.

242. We significantly note that extra precautionary efforts by national authorities to reduce exposure below recognized scientifically-based limits is considered by the WHO to be unnecessary but acceptable so long as such efforts do not undermine exposure limits based on known adverse effects.⁴²⁹ Along these lines, we note that although the Commission supplies information to consumers on methods to reduce exposure from cell phones, it has also stated that it does not endorse the need for nor set a target value for exposure reduction, and we seek comment on whether these policies are appropriate. We also observe that the FDA has stated that, “available scientific evidence—including World Health
(Continued from previous page) _____
and <http://www.fcc.gov/pea>. See also 47 C.F.R. § 1.1307(a). For example, towers could be located in a wilderness area or a flood plain.

⁴²⁷ According to Section 332(c)(7)(B)(iv) of the Communications Act of 1934, as amended, “[n]o State or local government or instrumentality thereof may regulate the placement, construction, and modification of personal wireless service facilities on the basis of the environmental effects of radio frequency emissions to the extent that such facilities comply with the Commission’s regulations concerning such emissions.”

⁴²⁸ See Tübiana M., Centre Antoine Bécélère, Faculté de Médecine, Paris, [*Conclusions. The Precautionary Principle: Its Advantages and Risks*] [Abstract Only], Bull Acad Natl Med. 2000; 184(5):969-93, <http://www.ncbi.nlm.nih.gov/pubmed/11077719>.

⁴²⁹ See World Health Organization (WHO), *Model Legislation for Electromagnetic Fields Protection*, Articles 2.1, 7.4 and 7.5, 2006, ISBN 978 92 4 159432 5, http://www.who.int/peh-emf/standards/EMF_model_legislation_2007.pdf

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Organization (WHO) findings released May 17, 2010—shows no increased health risk due to radiofrequency (RF) energy, a form of electromagnetic radiation that is emitted by cell phones.”⁴³⁰ At the same time, the FDA has stated that “[a]lthough the existing scientific data do not justify FDA regulatory actions, FDA has urged the cell phone industry to take a number of steps, including ... [d]esign[ing] cell phones in a way that minimizes any RF exposure to the user.”⁴³¹ We seek information on other similar hortatory efforts and comment on the utility and propriety of such messaging as part of this Commission’s regulatory regime.

243. While we may not take further action related to the regulatory concepts discussed here, we request comment on the financial impact and the introduction of regulatory uncertainty due to any initiative to minimize exposure beyond scientifically-established specific limits.

4. Evaluation

244. Evaluation is a rapidly evolving area, keeping pace with technological changes, that is most effectively guided by good engineering practice rather than specific regulations. As noted above, we use the term “evaluation” to mean the determination of compliance with our exposure limits by measurement or computation.⁴³² Evaluation is objectively verifiable in principle, even when various methods are used. However, engineering decisions or assumptions are sometimes required based on limited information. These assumptions are generally argued to be conservative, but verification of these assumptions is not always straightforward. On occasion, some prior presumably conservative assumption is later found to be questionable and warrants further analysis. While non-mandatory evaluation techniques are referenced and reflected in our OET Bulletins and in the FCC Laboratory Knowledge Database (KDB), development of them is the result of international engineering efforts by standards setting groups of the IEEE and International Electrotechnical Commission (IEC) and is generally self-correcting as information and analysis becomes more readily available. These are often dosimetric issues that can be resolved by our reliance on SAR as a primary metric for compliance. However, SAR measurement and modeling methods themselves are complex and continue to evolve to achieve greater accuracy. In particular, SAR evaluation for portable devices (*e.g.*, cell phones) has been a significant undertaking and standards development in this area is a continuous process.

245. Except for the extremities, our SAR limits for the general public are 0.08 W/kg, as averaged over the whole body, and a peak spatial-average SAR of 1.6 W/kg, averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and refer to continuous exposure over time. Evaluation with respect to the SAR limits “must demonstrate compliance with both the whole-body and peak spatial-average limits using technically supportable methods and exposure conditions in advance of authorization (licensing or equipment certification) and in a manner that permits independent assessment.”⁴³³ While these regulations refer to a cube of tissue, measurement standards have used simplified adult human models, and computational methods may be subject to errors where modeling requirements are not standardized. Most evaluations submitted to the Commission are based on

⁴³⁰ See U.S. Food and Drug Administration, *No Evidence Linking Cell Phone Use to Risk of Brain Tumors*, <http://www.fda.gov/ForConsumers/ConsumerUpdates/ucm212273.htm>.

⁴³¹ See U.S. Food and Drug Administration, *Radiation-Emitting Products – Cell Phones – Research*, <http://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/HomeBusinessandEntertainment/CellPhones/ucm116335.htm>.

⁴³² See para. 18 *supra*.

⁴³³ See the final rules, § 1.1310, in Appendix A *infra*.

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measurement using the standardized specific anthropomorphic mannequin (SAM).⁴³⁴ The SAM does not model children, tissue layers, or a hand holding the device but SAM was designed to be conservative relative to these factors.⁴³⁵ Computational standards can in principle more realistically model a range of variables not present using mannequins. Various numerical models of humans (both male and female of different age groups) have been developed, and presumably CAD models of devices can also be made available. However, using this information to produce accurate and practical computational models for individual devices to evaluate SAR on a routine basis may not be ideal for all situations. Since it is not possible to measure the SAR in a 1-gram cube of tissue within the head of a real human being, and given that each human being is different, we request comment on the pros and cons of measurement versus computation, as well as standardization of human models in general, and the significance of these issues in comparison with procedures that have already been standardized. We recognize that a measurement model is standardized by IEEE with the SAM for the head and a flat model for the body; however we seek comment on whether computation should use the same modeling and test configurations as used for measurement to maintain consistency of results and/or whether more complex human models should be used for computation.

246. As we have established in the *Order* adopted *supra*,⁴³⁶ both whole-body and localized SAR are primary metrics for compliance in the frequency range from 100 kHz to 6 GHz for exposure. Other than in the area of portable devices, development of standard procedures for SAR evaluation is more limited. While we generally state that we require appropriate practices using technically supportable methods for all cases, because of the lack of standard procedures, we request comment on how SAR evaluation methods should be supported for fixed and mobile RF sources. We also realize that there may be limitations with any approach to evaluation of SAR due to fixed RF sources, and that the existing MPE limits may not ensure SAR compliance in all cases, in particular where whole-body spatial averaging is used.⁴³⁷ While this dosimetric issue may be resolved in newer versions of standards, we mention it here because of its close connection with evaluation using SAR. We request information to address these issues. Since no OET Bulletin 65 supplement has yet focused on measurement procedures (or SAR evaluation) near fixed RF sources, we request comment on whether we should develop a future technical supplement to OET Bulletin 65 for fixed evaluation including SAR recognizing the development of the IEC 62232 base station standard.⁴³⁸

247. OET Bulletin 65 (including its Supplements) is not mandatory. Rather, the Bulletins provide non-binding policy statements on the procedures available for demonstrating compliance with the RF safety rules. We seek comment as to whether some material in the KDB that should be made mandatory, or in other words, is more appropriately included in the rules so that they would become enforceable requirements. We have already proposed this for some material in the *Further Notice*. In

⁴³⁴ The standard procedure for measurement evaluation involves a specific anthropomorphic mannequin (SAM) in accord with IEEE Std 1528-2003. The SAM is based on a simplified adult human head model with uniform dielectric properties. When a portable device is held to the SAM head during evaluation, a plastic pinna spacer is used to simulate the separation distance from the head caused by the pinna, but without a model of the hand. See Douglas, M. G., et. al., *Hand Phantom Models for the Assessment of SAR in the Head from Cellular Telephones*, Asia-Pacific Symposium on Electromagnetic Compatibility (APEMC), 12-16 April 2010, pp. 385 – 388.

⁴³⁵ See para. 219 *supra*.

⁴³⁶ *Report and Order*, in ET Docket 03-137.

⁴³⁷ See Kühn, S., et. al., *Assessment of Induced Radio-Frequency Electromagnetic Fields in Various Anatomical Human Body Models*, Phys. Med. Biol. 54 875–890, 2009.

⁴³⁸ See [International Electrotechnical Commission](http://www.iec.ch/), *Determination of RF field strength and SAR in the vicinity of radiocommunication base stations for the purpose of evaluating human exposure*, 62232 ed. 1.0, TC/SC 106, 2011, <http://www.iec.ch/>.

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addition to the proposed retirement of Supplement C and its replacement by the KDB,⁴³⁹ we will review the scope of remaining OET Bulletins 56 and 65 to determine whether any suggestions remaining in those bulletins should be removed, and included in a future Notice of Proposed Rulemaking to consider making them mandatory. We ask interested parties for suggestions for changes to these documents.

5. Proximity Restriction and Disclosure Requirements for Portable RF Sources

248. Since 2001, Supplement C of OET Bulletin 65, Edition 01-01, (Supplement C)⁴⁴⁰ has recommended maintaining a body-worn⁴⁴¹ device separation distance up to 2.5 cm (about one inch) during testing of consumer portable devices,⁴⁴² since accessories such as holsters would normally be used to wear devices on the body and maintain this distance. Note that, in contrast to the body-worn testing configuration, for consumer portable devices intended to be held against the head during normal use, the device must be placed directly against a head mannequin during testing.⁴⁴³ Manufacturers have been encouraged since 2001 to include information in device manuals to make consumers aware of the need to maintain the body-worn distance – by using appropriate accessories if they want to ensure that their actual exposure does not exceed the SAR measurement obtained during testing. The testing data for body-worn configurations would not be applicable to situations in which a consumer disregards this information on separation distance and maintains a device closer to the body than the distance at which it is tested. In such situations, it could be possible that exposure in excess of our limits might result, but only with the device transmitting continuously and at maximum power – such as might happen during a call with a headset and the phone in a user's pocket at the fringe of a reception area.

249. Handsets and wireless technologies have evolved significantly since the release of Supplement C. Body-worn accessories such as holsters have become a matter of consumer choice and are not always supplied with the device. The availability of low power Bluetooth headsets has enabled cell phones to be used away from the head, which may reduce exposure to the head. However, because today's cell phones are smaller and typically have no external antenna, the phone may be placed in a shirt or pants pocket against the body without the consumer appreciating that it is still transmitting. Handsets may also include wireless router functions that require simultaneous transmission of multiple transmitters to support unattended body-worn operations where, unlike with a traditional voice call, users are unaware that transmissions are occurring. With the introduction of LTE technologies (4G), handsets are operating with multiple higher-output power transmitters, which enable simultaneous voice and data connections in both next-to-ear and body-worn use configurations.

250. As devices have continued to evolve, so too have our policies. Portable devices must comply with the localized SAR limits as they are normally used. In fact, we have established evaluation procedures for newer technologies with reduced body-worn separation distances as small as 0.5

⁴³⁹ See para. 174 *supra*.

⁴⁴⁰ The Commission plans to retire the usage of OET Bulletin 65 Supplement C. See para. 174 *supra*. However, we provide this reference as a reflection on its past policy and as a rationale for this discussion herein.

⁴⁴¹ The term “body-worn” refers to circumstances where portable devices are physically worn against the body, which corresponds to SAR testing procedures using a flat body model. Examples of a body-worn usage configuration include operation using a headset while the device is in a pocket, holster, or clip. Thus, usage with the device held against the head (*i.e.*, held to the ear) is not considered body-worn, and compliance with the SAR limits are established using a special head mannequin with a simulated plastic pinna (outer ear).

⁴⁴² Portable devices are designed to be used within 20 centimeters of the user are the subject of this section. For mobile consumer devices where the a separation distance of at least 20 cm is normally maintained, we will continue to allow awareness of exposure from devices to be accomplished by the use of advisory labels and by providing users with information concerning minimum separation distances from transmitting structures and proper installation of antennas, as established in the *Order* adopted *supra*, in ET Docket 03-137.

⁴⁴³ See footnotes 434 and 441 *supra*. See also footnote 447 *infra*.

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centimeters.⁴⁴⁴ Manufacturers have achieved compliance using various methods. Some have used proximity sensors to reduce power when close to the body of the user, although device power reduction in general may degrade performance. Others have simply reduced the power of the device or changed its design. The manual should include operating instructions and advisory statements so that users are aware of the body-worn operating requirements for RF exposure compliance. This allows users to make informed decisions on the type of body-worn accessories and operating configurations that are appropriate for the device.⁴⁴⁵

251. Commission calculations similar to those in Appendix D suggest that some devices may not be compliant with our exposure limits without the use of some spacer to maintain a separation distance when body-worn,⁴⁴⁶ although this conclusion is not verifiable for individual devices since a test without a spacer has not been routinely performed during the body-worn testing for equipment authorization. Yet, we have no evidence that this poses any significant health risk. Commission rules specify a pass/fail criterion for SAR evaluation and equipment authorization. However, exceeding the SAR limit does not necessarily imply unsafe operation, nor do lower SAR quantities imply “safer” operation. The limits were set with a large safety factor, to be well below a threshold for unacceptable rises in tissue temperature. As a result, exposure well above the specified SAR limit should not create an unsafe condition. We note that, even if a device is tested without a spacer, there are already certain separations built into the SAR test setup, such as the thickness of the mannequin shell, the thickness of the device exterior case, *etc.*, so we seek comment on the implementation of evaluation procedures without a spacer for the body-worn testing configuration. We also realize that SAR measurements are performed while the device is operating at its maximum capable power, so that given typical operating conditions, the SAR of the device during normal use would be less than tested. In sum, using a device against the body without a spacer will generally result in actual SAR below the maximum SAR tested; moreover, a use that possibly results in non-compliance with the SAR limit should not be viewed with significantly greater concern than compliant use.

252. In sum, there could be certain circumstances where test configurations may not reflect actual use, and newer technological solutions may exist to allow for devices to be evaluated as close as is feasible to a simulated human under a body-worn configuration. Accordingly, we invite comment as to what steps, if any, the Commission should take relative to our policies for testing of devices on the basis of an expectation of some separation from the body, including whether it is appropriate to consider “zero” spacing, or actual contact with the body when testing.⁴⁴⁷ We also seek comment on the potential negative impacts of such measuring protocols on the design and performance of portable devices and, by extension, network architecture. Alternatively, we seek comment on whether both requiring that advisory

⁴⁴⁴ See KDB 941225 at <http://apps.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?switch=P&id=26930>.

⁴⁴⁵ OET Bulletin 65, Supplement C, Page 43.

⁴⁴⁶ See footnote 441 *supra*. See also footnote 447 *infra*.

⁴⁴⁷ We also take this opportunity to clarify a misconception, apparently held by some in the public, of our policy dealing with separation distance between portable devices and the body. Some cell phone users apparently believe that certain devices need to be kept at least a specified distance (up to 2.5 cm) from the head during normal use to ensure compliance with our SAR limits. Such a requirement does not exist and would clearly be impractical. The testing recommendation in Supplement C (Edition 01-01) allowing for up to 2.5 cm of separation from the body using spacers for SAR measurement applied only to body-worn operation and reflected, for example, the use of belt-clips or holsters or keeping the device in a purse or backpack. For the purpose of SAR determination, the human head and the body are simulated differently. Laboratories perform SAR measurements using a head-shaped mannequin for testing devices held next to the head but use a flat body model for testing to simulate body-worn use. No spacers are allowed when the device is held to the head mannequin; however, since the body-worn test has been typically conducted with a spacer to separate the device from the body by some distance, the same distance must be maintained during body-worn use for compliance to be ensured.

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information be more prominent and detailed⁴⁴⁸ and supplying accessories to the consumer could be an effective means to ensure adequate awareness and capability to ensure adherence to the SAR standards under all potential usage conditions. Given the considerable safety margin in our requirements, would the potential number of occurrences resulting from inattention to manual instruction and the extent of resulting exposure constitute a health hazard? We request information on the costs and benefits of these or other options that will help the Commission progress on this front.

VI. PROCEDURAL MATTERS**A. Final and Initial Regulatory Flexibility Analysis**

253. As required by § 603 of the Regulatory Flexibility Act, 5 U.S.C. § 603, the Commission has prepared a Final Regulatory Flexibility Analysis of the possible economic impact on small entities of the policies and rules adopted in this *First Report and Order*. This Final Regulatory Flexibility Analysis is set forth in Appendix E.

254. As required by the Regulatory Flexibility Act of 1980 (RFA),⁴⁴⁹ the Commission has prepared an Initial Regulatory Flexibility Analysis (IRFA) of the possible significant economic impact on small entities of the policies and rules proposed in the *Further Notice*. The IRFA is found in Appendix F. We request written public comment on the analysis. Comments must be filed in accordance with the same deadlines as comments filed in response to the *Further Notice*, and must have a separate and distinct heading designating them as responses to the IRFA.

B. Paperwork Reduction Act Analysis

255. This *Report and Order* contains modified information collection requirements subject to the Paperwork Reduction Act of 1995 (PRA), Public Law 104-13. It will be submitted to the Office of Management and Budget (OMB) for review under Section 3507(d) of the PRA. OMB, the general public, and other federal agencies are invited to comment on the new or modified information collection requirements contained in this proceeding. In addition, we note that pursuant to the Small Business Paperwork Relief Act of 2002, Public Law 107-198, *see* 44 U.S.C. 3506(c)(4), we previously sought specific comment on how the Commission might further reduce the information collection burden for small business concerns with fewer than 25 employees.

256. We received no comments in response to our request in the *Notice* dealing with information collection burdens for small businesses with fewer than 25 employees. In this present document, we have imposed stricter requirements on RF safety labeling of mobile and portable occupational transmitting devices and for occupational RF safety training in the vicinity of fixed transmitter sites. A sample of a portable or mobile occupational device RF safety label must be submitted with an application for equipment authorization. Such applications are normally submitted by manufacturers or importers of portable or mobile occupational devices, which generally tend to be large businesses. We are not aware that any of these businesses have fewer than 25 employees. While we are aware of numerous businesses with fewer than 25 employees which may now be subject to our new requirements for RF safety training, none of the rules adopted in this *First Report and Order* affect the information collection requirements applicable to businesses with fewer than 25 employees.

257. This *Further Notice of Proposed Rulemaking* contains proposed modified information collection requirements. The Commission, as part of its continuing effort to reduce paperwork burdens, invites the general public and the Office of Management and Budget (OMB) to comment on the

⁴⁴⁸ *See* § 2.1093(d)(1) of Appendix A for required advisory information for occupational use of portable devices.

⁴⁴⁹ *See* 5 U.S.C. § 603.

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information collection requirements contained in this document, as required by the Paperwork Reduction Act of 1995, Public Law 104-13. In addition, pursuant to the Small Business Paperwork Relief Act of 2002, Public Law 107-198, *see* 44 U.S.C. 3506(c)(4), we seek specific comment on how we might further reduce the information collection burden for small business concerns with fewer than 25 employees.

258. In addition to filing comments with the Secretary, a copy of any comments on the information collections contained herein should be submitted to Nicholas A. Fraser, Office of Management and Budget (OMB), (202) 395-5887, or via fax at (202) 395-5167, or via the Internet at Nicholas_A.Fraser@omb.eop.gov and to Judith-B.Herman@fcc.gov, Federal Communications Commission (FCC). To submit your comments by e-mail send them to: PRA@fcc.gov.

C. Filing Requirements

259. Pursuant to sections 1.415 and 1.419 of the Commission's rules 47 CFR §§ 1.415, 1.419, interested parties may file comments and reply comments on or before the dates indicated on the first page of this document. Comments may be filed using the Commission's Electronic Comment Filing System (ECFS). *See Electronic Filing of Documents in Rulemaking Proceedings*, 63 FR 24121 (1998).

- Electronic Filers: Comments may be filed electronically using the Internet by accessing the ECFS: <http://fjallfoss.fcc.gov/ecfs2/>.
- Paper Filers: Parties who choose to file by paper must file an original and one copy of each filing. Parties filing comments and/or replies in response to the *Further Notice of Proposed Rulemaking* must file their documents in ET Docket No. 03-137. Parties filing comments and/or replies in response to the *Notice of Inquiry* must file their documents in ET Docket No. 13-84.
- Filings can be sent by hand or messenger delivery, by commercial overnight courier, or by first-class or overnight U.S. Postal Service mail. All filings must be addressed to the Commission's Secretary, Office of the Secretary, Federal Communications Commission.
 - All hand-delivered or messenger-delivered paper filings for the Commission's Secretary must be delivered to FCC Headquarters at 445 12th St., SW, Room TW-A325, Washington, DC 20554. The filing hours are 8:00 a.m. to 7:00 p.m. All hand deliveries must be held together with rubber bands or fasteners. Any envelopes and boxes must be disposed of before entering the building.
 - Commercial overnight mail (other than U.S. Postal Service Express Mail and Priority Mail) must be sent to 9300 East Hampton Drive, Capitol Heights, MD 20743.
 - U.S. Postal Service first-class, Express, and Priority mail must be addressed to 445 12th Street, SW, Washington DC 20554.

260. People with Disabilities: To request materials in accessible formats for people with disabilities (braille, large print, electronic files, audio format), send an e-mail to fcc504@fcc.gov or call the Consumer & Governmental Affairs Bureau at (202) 418-0530 (voice), (202) 418-0432 (tty).

261. For further information, send an e-mail to Ed Mantiply at ed.mantiply@fcc.gov, Martin Doczkat at martin.doczkat@fcc.gov, or the Commission's RF Safety Program at rfsafety@fcc.gov, or call the Office of Engineering and Technology at (202) 418-2470.

D. Ex Parte Rules

262. The proceeding this Notice initiates shall be treated as a "permit-but-disclose" proceeding in accordance with the Commission's *ex parte* rules.⁴⁵⁰ Persons making *ex parte* presentations must file a

⁴⁵⁰ 47 C.F.R. §§ 1.1200 *et seq.*

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copy of any written presentation or a memorandum summarizing any oral presentation within two business days after the presentation (unless a different deadline applicable to the Sunshine period applies). Persons making oral *ex parte* presentations are reminded that memoranda summarizing the presentation must (1) list all persons attending or otherwise participating in the meeting at which the *ex parte* presentation was made, and (2) summarize all data presented and arguments made during the presentation. If the presentation consisted in whole or in part of the presentation of data or arguments already reflected in the presenter's written comments, memoranda or other filings in the proceeding, the presenter may provide citations to such data or arguments in his or her prior comments, memoranda, or other filings (specifying the relevant page and/or paragraph numbers where such data or arguments can be found) in lieu of summarizing them in the memorandum. Documents shown or given to Commission staff during *ex parte* meetings are deemed to be written *ex parte* presentations and must be filed consistent with rule 1.1206(b). In proceedings governed by rule 1.49(f) or for which the Commission has made available a method of electronic filing, written *ex parte* presentations and memoranda summarizing oral *ex parte* presentations, and all attachments thereto, must be filed through the electronic comment filing system available for that proceeding, and must be filed in their native format (e.g., .doc, .xml, .ppt, searchable .pdf). Participants in this proceeding should familiarize themselves with the Commission's *ex parte* rules.

E. Congressional Review Act

263. The Commission will send a copy of the Report and Order to Congress and the Government Accountability Office pursuant to the Congressional Review Act.⁴⁵¹

VII. ORDERING CLAUSES

264. Accordingly, IT IS ORDERED, that pursuant to Sections 1, 4(i), 4(j), 301, 303(r), 307, 308, 309, 332(a)(1), 332(c)(7)(B)(iv), and 403 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 151, 154(i), 154(j), 301, 303(r), 307, 308, 309, 332(a)(1), 332(c)(7)(B)(iv), 403; the National Environmental Policy Act of 1969, 42 U.S.C. § 4321, *et seq.*; and Section 704(b) of the Telecommunications Act of 1996, Pub. L. No. 104-104, this *First Report and Order* **IS HEREBY ADOPTED**.

265. IT IS FURTHER ORDERED that the Commission's rules **ARE AMENDED** as set forth in Appendix A. These rule revisions in this *First Report and Order* will become effective **[60 DAYS AFTER DATE OF PUBLICATION FEDERAL REGISTER]**, except for Section 2.1091(d)(3) of the rule which contains information collection requirements subject to the Paperwork Reduction Act of 1995, Public Law 104-13, that are not effective until approved by the Office of Management and Budget (OMB). The Federal Communications Commission will publish a document in the Federal Register announcing OMB approval and the effective date of this rule.

266. IT IS FURTHER ORDERED, that pursuant to the authority contained in Sections 1, 4(i), 4(j), 301, 303(r), 307, 308, 309, 332(a)(1), 332(c)(7)(B)(iv), and 403 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 151, 154(i), 154(j), 301, 303(r), 307, 308, 309, 332(a)(1), 332(c)(7)(B)(iv), 403; the National Environmental Policy Act of 1969, 42 U.S.C. § 4321, *et seq.*; and Section 704(b) of the Telecommunications Act of 1996, Pub. L. No. 104-104, this *Further Notice of Proposed Rulemaking* **IS ADOPTED** and comments will be sought on these proposals.

267. IT IS FURTHER ORDERED, that pursuant to Sections 1, 4(i), 4(j), 301, 303(r), 307, 308, 309, 332(a)(1), 332(c)(7)(B)(iv), and 403 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 151, 154(i), 154(j), 301, 303(r), 307, 308, 309, 332(a)(1), 332(c)(7)(B)(iv), 403; the National Environmental Policy Act of 1969, 42 U.S.C. § 4321, *et seq.*; and Section 704(b) of the

⁴⁵¹ See 5 U.S.C. § 801(a)(1)(A).

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Telecommunications Act of 1996, Pub. L. No. 104-104, this *Notice of Inquiry* **IS ADOPTED** and comment will be sought.

268. IT IS ALSO ORDERED that the Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, **SHALL SEND** a copy of this *Further Notice of Proposed Rulemaking*, including the Initial Regulatory Flexibility Analysis, to the Chief Counsel for Advocacy of the Small Business Administration.

269. IT IS FURTHER ORDERED, that the Commission's Consumer and Governmental Affairs Bureau, Reference Information Center **SHALL SEND** a copy of the *First Report and Order*, including the Final Regulatory Flexibility Analysis, to the Government Accountability Office pursuant to the Congressional Review Act, see 5 U.S.C. 801(a)(1)(A). A copy of the *First Report and Order* and FRFA (or summaries thereof) will also be published in the Federal Register.

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch
Secretary

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APPENDIX A

Final Rules

For the reasons set forth above, Parts 1, 2, and 95 of title 47 of the Code of Federal Regulations are amended as follows:

PART 1 – PRACTICE AND PROCEDURE

1. The authority citation for Part 1 continues to read as follows:

Authority: 15 U.S.C. 79 et seq.; 47 U.S.C. 151, 154(i), 154(j), 155, 157, 225, 227, 303(r), and 309

2. Section 1.1307(b) is amended by revising paragraph (b)(2) to read as follows:

§1.1307 Actions that may have a significant environmental effect, for which Environmental Assessments (EAs) must be prepared.

* * * * *

(b) * * *

(1) * * *

(2)(i) Mobile and portable transmitting devices that operate in the Commercial Mobile Radio Services pursuant to part 20 of this chapter; the Cellular Radiotelephone Service pursuant to part 22 of this chapter; the Personal Communications Services (PCS) pursuant to part 24 of this chapter; the Satellite Communications Services pursuant to part 25 of this chapter; the Miscellaneous Wireless Communications Services pursuant to part 27 of this chapter; the Maritime Services (ship earth stations only) pursuant to part 80 of this chapter; the Specialized Mobile Radio Service, the 4.9 GHz Band Service, or the 3650 MHz Wireless Broadband Service pursuant to part 90 of this chapter; or the Wireless Medical Telemetry Service (WMTS), or the Medical Device Radiocommunication Service (MedRadio) pursuant to part 95 of this chapter are subject to routine environmental evaluation for RF exposure prior to equipment authorization or use, as specified in §§ 2.1091 and 2.1093 of this chapter.

(ii) Unlicensed PCS, unlicensed NII and millimeter wave devices are also subject to routine environmental evaluation for RF exposure prior to equipment authorization or use, as specified in §§ 15.253(f), 15.255(g), 15.257(g), 15.319(i), and 15.407(f) of this chapter.

(iii) Portable transmitting equipment for use in the Wireless Medical Telemetry Service (WMTS) is subject to routine environment evaluation as specified in §§ 2.1093 and 95.1125 of this chapter.

(iv) Equipment authorized for use in the Medical Device Radiocommunication Service (MedRadio) as a medical implant device or body-worn transmitter (as defined in Appendix 1 to Subpart E of part 95 of this chapter) is subject to routine environmental evaluation for RF exposure prior to equipment authorization, as specified in §§ 2.1093 and 95.1221 of this chapter by finite difference time domain (FDTD) computational modeling or laboratory measurement techniques. Where a showing is based on computational modeling, the Commission retains the discretion to request that supporting documentation and/or specific absorption rate (SAR) measurement data be submitted.

(v) All other mobile, portable, and unlicensed transmitting devices are categorically excluded from routine environmental evaluation for RF exposure under §§ 2.1091, 2.1093 of this chapter except as specified in paragraphs (c) and (d) of this section.

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(3) * * *

3. Section 1.1307(b)(4) is deleted.
4. Section 1.1307(b)(5) is deleted.
5. Section 1.1310 is amended to read as follows:

§ 1.1310 Radiofrequency radiation exposure limits.

(a) Specific absorption rate (SAR) shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in § 1.1307(b) within the frequency range of 100 kHz to 6 GHz (inclusive).

(b) The SAR limits for occupational/controlled exposure are 0.4 W/kg, as averaged over the whole body, and a peak spatial-average SAR of 8 W/kg, averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the parts of the human body treated as extremities, such as hands, wrists, feet, ankles, and pinnae, where the peak spatial-average SAR limit for occupational/controlled exposure is 20 W/kg, averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). Exposure may be averaged over a time period not to exceed 6 minutes to determine compliance with occupational/controlled SAR limits.

(c) The SAR limits for general population/uncontrolled exposure are 0.08 W/kg, as averaged over the whole body, and a peak spatial-average SAR of 1.6 W/kg, averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the parts of the human body treated as extremities, such as hands, wrists, feet, ankles, and pinnae, where the peak spatial-average SAR limit is 4 W/kg, averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). Exposure may be averaged over a time period not to exceed 30 minutes to determine compliance with general population/uncontrolled SAR limits.

(d)(1) Evaluation with respect to the SAR limits in this section and in § 2.1093 of this chapter must demonstrate compliance with both the whole-body and peak spatial-average limits using technically supportable methods and exposure conditions in advance of authorization (licensing or equipment certification) and in a manner that permits independent assessment.

(2) At operating frequencies less than or equal to 6 GHz, the limits for maximum permissible exposure (MPE), derived from whole-body SAR limits and listed in Table 1 of paragraph (e) of this section, may be used instead of whole-body SAR limits as set forth in paragraph (a) through (c) of this section to evaluate the environmental impact of human exposure to RF radiation as specified in § 1.1307(b), except for portable devices as defined in § 2.1093 as these evaluations shall be performed according to the SAR provisions in § 2.1093 of this chapter.

(3) At operating frequencies above 6 GHz, the MPE limits shall be used in all cases to evaluate the environmental impact of human exposure to RF radiation as specified in § 1.1307(b).

(4) Both the MPE limits listed in Table 1 of paragraph (e) of this section and the SAR limits as set forth in paragraph (a) through (c) of this section and in § 2.1093 of this chapter are for continuous exposure, that is, for indefinite time periods. Exposure levels higher than the limits are permitted for shorter exposure times, as long as the average exposure over the specified averaging time in Table 1 is less than the limits. Detailed information on our policies regarding procedures for evaluating compliance with all of these exposure limits can be found in the FCC's *OET Bulletin 65*, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields,"

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and in supplements to *Bulletin 65*, all available at the FCC's Internet Web site:

<http://www.fcc.gov/oet/rfsafety>.

Note to Paragraphs (a) through (d): SAR is a measure of the rate of energy absorption due to exposure to RF electromagnetic energy. The SAR limits to be used for evaluation are based generally on criteria published by the American National Standards Institute (ANSI) for localized SAR in Section 4.2 of "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," ANSI/IEEE Std C95.1-1992, copyright 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. The criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," NCRP Report No. 86, Section 17.4.5, copyright 1986 by NCRP, Bethesda, Maryland 20814. Limits for whole body SAR and peak spatial-average SAR are based on recommendations made in both of these documents. The MPE limits in Table 1 are based generally on criteria published by the NCRP in "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," NCRP Report No. 86, Sections 17.4.1, 17.4.1.1, 17.4.2 and 17.4.3, copyright 1986 by NCRP, Bethesda, Maryland 20814. In the frequency range from 100 MHz to 1500 MHz, these MPE exposure limits for field strength and power density are also generally based on criteria recommended by the ANSI in Section 4.1 of "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," ANSI/IEEE Std C95.1-1992, copyright 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017.

(e) Table 1 below sets forth limits for Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic fields.

Table 1—Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3 – 3.0	614	1.63	100 *	6
3.0 – 30	1842/f	4.89/f	900/f ² *	6
30 – 300	61.4	0.163	1.0	6
300 – 1,500	–	–	f/300	6
1,500 – 100,000	–	–	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3 – 1.34	614	1.63	100 *	30
1.34 – 30	824/f	2.19/f	180/f ² *	30
30 – 300	27.5	0.073	0.2	30
300 – 1,500	–	–	f/1500	30
1,500 – 100,000	–	–	1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

(1) Occupational/controlled exposure limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when a person is transient through a location where occupational/controlled limits apply

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provided he or she is made aware of the potential for exposure. The phrase *fully aware* in the context of applying these exposure limits means that an exposed person has received written and/or verbal information fully explaining the potential for RF exposure resulting from his or her employment. With the exception of *transient* persons, this phrase also means that an exposed person has received appropriate training regarding work practices relating to controlling or mitigating his or her exposure. Such training is not required for *transient* persons, but they must receive written and/or verbal information and notification (for example, using signs) concerning their exposure potential and appropriate means available to mitigate their exposure. The phrase *exercise control* means that an exposed person is allowed to and knows how to reduce or avoid exposure by administrative or engineering controls and work practices, such as use of personal protective equipment or time averaging of exposure.

(2) General population/uncontrolled exposure limits apply in situations in which the general public may be exposed, or in which persons who are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

(3) Licensees and applicants are responsible for compliance with both the occupational/controlled exposure limits and the general population/uncontrolled exposure limits as they apply to transmitters under their jurisdiction. Licensees and applicants should be aware that the occupational/controlled exposure limits apply especially in situations where workers may have access to areas in very close proximity to antennas and access to the general public may be restricted.

(4) In lieu of evaluation with the general population/uncontrolled exposure limits, amateur licensees authorized under part 97 of this chapter and members of his or her immediate household may be evaluated with respect to the occupational/controlled exposure limits in this section, provided appropriate training and information has been provided to the amateur licensee and members of his/her household. Other nearby persons who are not members of the amateur licensee's household must be evaluated with respect to the general population/uncontrolled exposure limits.

PART 2 – FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS

6. The authority citation for Part 2 continues to read as follows:

Authority: 47 U.S.C. 154, 302a, 303, and 336, unless otherwise noted.

7. Section 2.1091 is amended by revising paragraphs (c) and (d)(3) to read as follows:

§ 2.1091 Radio frequency radiation exposure evaluation: mobile devices.

* * * * *

(c)(1) Mobile devices that operate in the Commercial Mobile Radio Services pursuant to part 20 of this chapter; the Cellular Radiotelephone Service pursuant to part 22 of this chapter; the Personal Communications Services pursuant to part 24 of this chapter; the Satellite Communications Services pursuant to part 25 of this chapter; the Miscellaneous Wireless Communications Services pursuant to part 27 of this chapter; the Maritime Services (ship earth station devices only) pursuant to part 80 of this chapter; and the Specialized Mobile Radio Service, and the 3650 MHz Wireless Broadband Service pursuant to part 90 of this chapter are subject to routine environmental evaluation for RF exposure prior to equipment authorization or use if:

- (i) they operate at frequencies of 1.5 GHz or below and their effective radiated power (ERP) is 1.5 watts or more, or

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(ii) they operate at frequencies above 1.5 GHz and their ERP is 3 watts or more.

(2) Unlicensed personal communications service devices, unlicensed millimeter wave devices and unlicensed NII devices authorized under §§ 15.253(f), 15.255(g), 15.257(g), 15.319(i), and 15.407(f) of this chapter are also subject to routine environmental evaluation for RF exposure prior to equipment authorization or use if their ERP is 3 watts or more or if they meet the definition of a portable device as specified in § 2.1093(b) requiring evaluation under the provisions of that section.

(3) All other mobile and unlicensed transmitting devices are categorically excluded from routine environmental evaluation for RF exposure prior to equipment authorization or use, except as specified in §§ 1.1307(c) and 1.1307(d) of this chapter.

(4) Applications for equipment authorization of mobile and unlicensed transmitting devices subject to routine environmental evaluation must contain a statement confirming compliance with the limits specified in paragraph (d) of this section. Technical information showing the basis for this statement must be submitted to the Commission upon request.

(d) * * *

(1) * * *

(2) * * *

(3) If appropriate, awareness of exposure from devices in this section can be accomplished by the use of visual advisories (such as labeling, embossing, or on an equivalent electronic display) and by providing users with information concerning minimum separation distances from radiating structures and proper installation of antennas.

(i) Visual advisories shall be legible and clearly visible to the user from the exterior of the device.

(ii) Visual advisories used on devices that are subject to occupational/controlled exposure limits must indicate that the device is for occupational use only, must refer the user to specific information on RF exposure, such as that provided in a user manual, and must note that the advisory and its information is required for FCC RF exposure compliance. Such instructional material must provide the user with information on how to use the device in order to ensure compliance with the occupational/controlled exposure limits.

(iii) A sample of the visual advisory, illustrating its location on the device, and any instructional material intended to accompany the device when marketed, shall be filed with the Commission along with the application for equipment authorization.

(iv) For occupational devices, details of any special training requirements pertinent to limiting RF exposure should also be submitted. Holders of grants for mobile devices to be used in occupational settings are encouraged, but not required, to coordinate with end-user organizations to ensure appropriate RF safety training.

* * * * *

8. Section 2.1093 is amended by revising paragraphs (c) and (d) to read as follows:

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§ 2.1093 Radiofrequency radiation exposure evaluation: portable devices.

* * * * *

(c)(1) Portable devices that operate in the Cellular Radiotelephone Service pursuant to part 22 of this chapter; the Personal Communications Service (PCS) pursuant to part 24 of this chapter; the Satellite Communications Services pursuant to part 25 of this chapter; the Miscellaneous Wireless Communications Services pursuant to part 27 of this chapter; the Maritime Services (ship earth station devices only) pursuant to part 80 of this chapter; the Specialized Mobile Radio Service, the 4.9 GHz Band Service, and the 3650 MHz Wireless Broadband Service pursuant to part 90 of this chapter; the Wireless Medical Telemetry Service (WMTS) and the Medical Device Radiocommunication Service (MedRadio), pursuant to subparts H and I of part 95 of this chapter, respectively, and unlicensed personal communication service, unlicensed NII devices and millimeter wave devices authorized under 15.253(f), 15.255(g), 15.257(g), 15.319(i), and 15.407(f) of this chapter are subject to routine environmental evaluation for RF exposure prior to equipment authorization or use.

(2) All other portable transmitting devices are categorically excluded from routine environmental evaluation for RF exposure prior to equipment authorization or use, except as specified in sections 1.1307(c) and 1.1307(d) of this chapter.

(3) Applications for equipment authorization of portable transmitting devices subject to routine environmental evaluation must contain a statement confirming compliance with the limits specified in paragraph (d) of this section. Technical information showing the basis for this statement must be submitted to the Commission upon request.

(d) * * *

(1) The SAR limits for occupational/controlled exposure are 0.4 W/kg, as averaged over the whole body, and a peak spatial-average SAR of 8 W/kg, averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the parts of the human body treated as extremities, such as hands, wrists, feet, ankles, and pinnae, where the peak spatial-average SAR limit for occupational/controlled exposure is 20 W/kg, averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). Exposure may be averaged over a time period not to exceed 6 minutes to determine compliance with occupational/controlled SAR limits.

(i) Occupational/Controlled limits apply when persons are exposed as a consequence of their employment provided these persons are fully aware of and exercise control over their exposure. Awareness of exposure can be accomplished by use of visual advisories (such as labeling, embossing, or on an equivalent electronic display) or by specific training or education through appropriate means, such as an RF safety program in a work environment.

(ii) Visual advisories on portable devices designed only for occupational use can be used as part of an applicant's evidence of the device user's awareness of occupational/controlled exposure limits.

(A) Such visual advisories shall be legible and clearly visible to the user from the exterior of the device.

(B) Visual advisories must indicate that the device is for occupational use only, refer the user to specific information on RF exposure, such as that provided in a user manual and note that the advisory and its information is required for FCC RF exposure compliance.

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(C) Such instructional material must provide the user with information on how to use the device in order to ensure compliance with the occupational/controlled exposure limits.

(D) A sample of the visual advisory, illustrating its location on the device, and any instructional material intended to accompany the device when marketed, shall be filed with the Commission along with the application for equipment authorization. Details of any special training requirements pertinent to limiting RF exposure should also be submitted.

(E) Holders of grants for portable devices to be used in occupational settings are encouraged, but not required, to coordinate with end-user organizations to ensure appropriate RF safety training.

(2) The SAR limits for general population/uncontrolled exposure are 0.08 W/kg, as averaged over the whole body, and a peak spatial-average SAR of 1.6 W/kg, averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the parts of the human body treated as extremities, such as hands, wrists, feet, ankles, and pinnae, where the peak spatial-average SAR limit is 4 W/kg, averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). Exposure may be averaged over a time period not to exceed 30 minutes to determine compliance with general population/uncontrolled SAR limits.

(i) General Population/Uncontrolled limits apply when the general public may be exposed, or when persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or do not exercise control over their exposure.

(ii) Visual advisories (such as labeling, embossing, or on an equivalent electronic display) on consumer devices such as cellular telephones will not be sufficient reason to allow these devices to be evaluated subject to limits for occupational/controlled exposure in paragraph (d)(1) of this section.

(3) Compliance with SAR limits can be demonstrated by either laboratory measurement techniques or by computational modeling. The latter must be supported by adequate documentation showing that the test device and exposure conditions have been correctly modeled in accordance with the operating configurations for normal use. Guidance regarding SAR measurement techniques can be found in the Office of Engineering and Technology (OET) Laboratory Division Knowledge Database (KDB). The staff guidance provided in the KDB does not necessarily represent the only acceptable methods for measuring RF exposure or emissions, and is not binding on the Commission or any interested party.

* * * * *

PART 95 – PERSONAL RADIO SERVICES

9. The authority citation for Part 95 continues to read as follows:

Authority: Secs. 4, 303, 48 Stat. 1066, 1082, as amended; 47 U.S.C. 154, 303.

10. Section 95.1221 is amended to read as follows:

§ 95.1221 RF exposure.

A MedRadio medical implant device or medical body-worn transmitter is subject to the radiofrequency radiation exposure requirements specified in §§ 1.1307(b) and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of devices operating under this section must demonstrate compliance with these requirements using either finite difference time domain (FDTD) computational

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modeling or laboratory measurement techniques. Where a showing is based on computational modeling, the Commission retains the discretion to request that supporting documentation and/or specific absorption rate (SAR) measurement data be submitted.

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APPENDIX B

Proposed Rules

For the reasons set forth above, Parts 1, 2, 15, 24, 25, 27, 73, 90, 95, 97, and 101 of title 47 of the Code of Federal Regulations are proposed to be amended as follows:

PART 1 – PRACTICE AND PROCEDURE

1. The authority citation for Part 1 continues to read as follows:

Authority: 15 U.S.C. 79 et seq.; 47 U.S.C. 151, 154(i), 154(j), 155, 157, 225, 227, 303(r), and 309.

2. Section 1.1307 is amended by revising paragraph (b) to read as follows:

§1.1307 Actions that may have a significant environmental effect, for which Environmental Assessments (EAs) must be prepared.

* * * * *

(b) In addition to the actions listed in paragraph (a) of this section, Commission actions granting or modifying construction permits, licenses or renewals thereof, temporary authorities, equipment authorizations, or any other authorizations for radiofrequency (RF) sources require the preparation of an Environmental Assessment (EA) if those RF sources would cause human exposure to levels of RF radiation in excess of the limits in § 1.1310 of this chapter. Applications to the Commission for construction permits, licenses or renewals thereof, temporary authorities, equipment authorizations, or any other authorizations requesting either approval or modification of RF sources must contain a statement confirming compliance by RF evaluation with the limits in § 1.1310 of this chapter unless those RF sources are exempt from such RF evaluation, as discussed below. Technical information showing the basis for compliance with the limits in § 1.1310 of this chapter, either by RF evaluation or exemption, must be submitted to the Commission upon request. Notwithstanding the above, in the event that RF sources cause human exposure to levels of RF radiation in excess of the limits in § 1.1310 of this chapter, such RF evaluations and exemptions are not deemed sufficient to show that there is no significant effect on the quality of the human environment or that the RF sources are categorically excluded from environmental processing.

(1) Evaluation of compliance with the exposure limits in § 1.1310 of this chapter is required only for RF sources not exempt from such evaluation. Evaluation of compliance with the exposure limits may be based on either computation or measurement in accordance with § 1.1310 of this chapter. Exemption from evaluation may be based on frequency, power, and separation distance. However, all single RF sources having less than an available maximum time-averaged power of 1 mW are exempt from evaluation, as specified in paragraph (b)(1)(iii) of this section. The “available maximum time-averaged power” for a fixed RF source is the maximum available power as averaged over any 30 minute time period, and for a mobile or portable RF source is the maximum available power as averaged over a period inherent from device transmission characteristics. Evaluation of compliance with the exposure limits in § 1.1310 of this chapter is necessary for single fixed, mobile, or portable RF sources above 1 mW and having an ERP greater than listed in Table 1 specified in paragraph (b)(1)(i) of this section or single fixed, mobile, or portable RF sources greater than the threshold P_{th} for separation distances between 0.5 cm and 20 cm (inclusive) or ERP_{20cm} for separation distances of at least 20 cm up to 40 cm as listed in paragraph (b)(1)(ii) of this section. Mobile devices, as defined in § 2.1091(b) of this chapter, and portable devices, as defined in § 2.1093(b) of this chapter, with multiple RF sources shall refer to §§ 2.1091(c) and 2.1093(c), respectively, for relevant exemption criteria. For the purposes of this section, a fixed RF source is defined as one that is physically secured at one location, even temporarily, and is not able to be easily moved to another location.

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(i) Evaluation of compliance with the exposure limits in § 1.1310 of this chapter, and preparation of an EA if the limits are exceeded, is necessary for single RF sources either above an available maximum time-averaged power of 1 mW or above the ERP listed in Table 1 below, whichever is greater. The ERP, defined as the product of the maximum antenna gain and the maximum delivered time-averaged power summed over all polarizations, shall be used for comparison with the value calculated from the applicable formula in Table 1, where the term “maximum antenna gain” is the largest far-field total power gain relative to a dipole in any direction for all transverse polarization components and the term “delivered maximum time-averaged power” is the largest net power delivered or supplied to the antenna as averaged over any 30 minute time period for fixed sources and as averaged over a period inherent from device transmission characteristics for mobile and portable sources. The term “separation distance,” R in Table 1, is defined as the minimum distance in any direction from any part of the radiating structure of a transmitting antenna or antenna array to the body of a nearby person.

Table 1—Single RF Sources Subject to Routine Environmental Evaluation

Transmitter Frequency (MHz)	Threshold ERP (watts)
Regardless of ERP, evaluation is required if the separation distance R is less than $\lambda/2\pi$ from the radiating structure, where λ is the free-space operating wavelength, unless the available maximum time-averaged power is less than one milliwatt. In addition, evaluation is required if the ERP in watts is greater than the value given by the formula below for the appropriate frequency, f , in MHz at the separation distance, R , in meters.	
0.3 – 1.34	$ERP \geq 1,920 R^2$
1.34 – 30	$ERP \geq 3,450 R^2/f^2$
30 – 300	$ERP \geq 3.83 R^2$
300 – 1,500	$ERP \geq 0.0128 R^2 f$
1,500 – 100,000	$ERP \geq 19.2 R^2$

(ii) Evaluation of compliance with the exposure limits in § 1.1310 of this chapter is necessary for single RF sources not exempted by paragraph (b)(1)(i) of this section if either its available maximum time-averaged power or effective radiated power (ERP) is greater than the threshold P_{th} listed in the formula below, which shall only be used at distances from 0.5 to 20 centimeters and at frequencies from 0.3 to 6 GHz. For distances from 20 to 40 centimeters at frequencies from 0.3 to 6 GHz, evaluation of compliance with the exposure limits in § 1.1310 of this chapter is necessary if the ERP is greater than ERP_{20cm} in the formula below. If the ERP of a single RF source at distances from 0.5 to 40 centimeters and at frequencies from 0.3 to 6 GHz is not easily obtained, then the available maximum time-averaged power may be used (*i.e.*, without consideration of ERP) in comparison with the formula below only if the device antenna(s) or radiating structure(s) do not exceed the electrical length of $\lambda/4$.

$$P_{th} \text{ (mW)} = ERP_{20cm} (d / 20 \text{ cm})^x$$

Where

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$$x = -\log_{10} \left(\frac{60}{ERP_{20cm} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}$$

$$ERP_{20cm} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

d = the minimum separation distance in any direction from any part of the device antenna(s) or radiating structure(s) to the body of the device user

(iii) In order for the 1 mW exemption criterion in paragraph (b)(1) of this section to apply, a separation distance of two centimeters is required between any portion of a radiating structure operating at less than 1 mW and the nearest portion of any other radiating structure in the same device.

(iv) A routine RF evaluation of compliance with the exposure limits in § 1.1310 of this chapter is necessary for single fixed RF sources that exceed the thresholds defined in paragraph (b)(1), (b)(1)(i), or (b)(1)(ii) of this section. Multiple fixed RF sources require evaluation of compliance with the exposure limits in § 1.1310 of this chapter if the sum of the fractional contributions to the applicable ERP thresholds and the ambient exposure quotient (AEQ) is greater than or equal to 1 as indicated in the equation below.

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \frac{\sum_{j=1}^b SAR_j}{1.6 \text{ W/kg}} + \sum_{k=1}^c \frac{ERP_k}{ERP_{th,k}} + AEQ \geq 1$$

Where

- a = number of fixed RF sources using paragraph (b)(1)(ii) of this section.
- b = number of existing fixed RF sources with known SAR.
- c = number of fixed RF sources using ERP, either according to (b)(1)(i) or (b)(1)(ii) of this section.
- P_i = the available maximum time-averaged power or the ERP, whichever is greater, for RF source i
- $P_{th,i}$ = the threshold power according to the formula in (b)(1)(ii) of this section for RF source i .
- SAR_j = the maximum SAR reported from the j^{th} fixed RF source.
- ERP_k = ERP of RF source k .
- $ERP_{th,k}$ = exemption threshold ERP for RF source k , either according to (b)(1)(ii) of this section or (b)(1)(i) of this section, as applicable.
- AEQ = the ambient exposure quotient (AEQ) for the general population/uncontrolled limit from an existing evaluation of exposure at the site from fixed sources not included in the summations. An AEQ less than 0.05 may be considered insignificant.

(v) Where applicable, for multiple mobile or portable RF sources within a device operating in the same time averaging period, evaluation is required if:

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \frac{\sum_{j=1}^b SAR_j}{1.6 \text{ W/kg}} + \sum_{k=1}^c \frac{ERP_k}{ERP_{th,k}} \geq 1$$

Where

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- a = number of mobile or portable transmitters that use P_{th} , including existing transmitters and those being added.
- b = number of existing mobile or portable transmitters with known SAR.
- c = number of mobile or portable transmitters using ERP, according to either (b)(1)(i) or (b)(1)(ii) of this section, including existing transmitters and those being added.
- P_i = the available maximum time-averaged power or the ERP, whichever is greater, for mobile or portable transmitter i.
- $P_{th,i}$ = the threshold power according to the formula in § 1.1307(b)(1)(ii) for mobile or portable transmitter i.
- SAR_j = the maximum SAR reported for equipment certification from the j^{th} mobile or portable transmitter in the device.
- ERP_k = ERP of mobile or portable transmitter k.
- $ERP_{th,k}$ = exemption threshold ERP for mobile or portable transmitter k, either according to (b)(1)(ii) of this section or (b)(1)(i) of this section, as applicable.

(vi) Unless otherwise specified in this chapter, any other single or multiple RF source(s) is exempt from routine environmental evaluation for RF exposure prior to authorization (licensing or equipment certification), except as specified in §§ 1.1307(c) and 1.1307(d) of this chapter.

(2) Specific mitigation actions are required for fixed RF sources in order to ensure compliance with our exposure limits, including the implementation of an RF safety plan, restriction of access to those RF sources, and disclosure of spatial regions where exposure limits are exceeded. For the purpose of this section, Category One described in paragraph (b)(2)(i) of this section is defined as compliant with the general population exposure limit in § 1.1310 of this chapter at any separation distance; Category Two described in paragraph (b)(2)(ii) of this section is defined as above the general population exposure limit but compliant with the occupational exposure limit in § 1.1310 of this chapter within its defined spatial region; Category Three described in paragraph (b)(2)(iii) of this section is defined as above the occupational exposure limit but no more than ten times the occupational exposure limit in § 1.1310 of this chapter within its defined spatial region; and Category Four described in paragraph (b)(2)(iv) of this section is defined as more than ten times the occupational exposure limit in § 1.1310 of this chapter within its defined spatial region.

(i) **Category One – INFORMATION:** No mitigation actions are required. Optionally a green “INFORMATION” sign may offer information to those persons who might be approaching RF sources. This optional sign should include at least the following information: appropriate signal word “INFORMATION” and associated color (green) in accord with section 5.8 of IEEE Std C95.2-1999, a specification of the RF source, contact information, and a reminder to obey all postings and boundaries.

(ii) **Category Two – NOTICE:** Mitigation actions are required in the form of signs and positive access control surrounding the areas in which the general population exposure limit is exceeded, with the appropriate signal word “NOTICE” and associated color (blue) on the signs. Signs must contain the components discussed in paragraph (b)(2)(v) of this section. Under certain controlled conditions, such as on a rooftop with limited access, a sign containing the components discussed in paragraph (b)(2)(v) of this section attached directly to the surface of an antenna will be considered a sufficient mitigation action if the sign specifies and is legible at the separation distance required for compliance with the general population exposure limit in § 1.1310 of this chapter. Appropriate training is required for any occupational personnel with access to controlled areas within restrictive barriers where the general population exposure limit is exceeded, and transient individuals must be supervised by trained personnel upon entering any of these areas.

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Use of time averaging is required for transient individuals in the area in which the general population exposure limit is exceeded to ensure compliance with the time-averaged general population exposure limit.

(iii) **Category Three – CAUTION:** In addition to the mitigation actions required within those areas designated as Category Two, further signs, controls, or indicators are required surrounding the area in which the occupational exposure limit is exceeded, with the appropriate signal word “CAUTION” and associated color (yellow) on the signs. If signs are used at the occupational exposure limit boundary, they must contain the components discussed in paragraph (b)(2)(v) of this section. If the boundaries between Category Two and Three are such that placement of both Category Two and Three signs would be in the same location, then the Category Two sign is optional. A label or small sign may be attached directly to the surface of an antenna within a controlled environment if it specifies a minimum approach distance where the occupational exposure limit is exceeded. If signs are not used at the occupational exposure limit boundary, controls or indicators (*e.g.*, chains, railings, contrasting paint, diagrams, *etc.*) must designate the spatial regions where the occupational exposure limit is exceeded. Transient individuals are not permitted in any area for any period of time in which the occupational exposure limit is exceeded. Further mitigation by reducing exposure time in accord with six minute time averaging is required for occupational personnel in the area in which the occupational exposure limit is exceeded. However, proper use of RF personal protective equipment may be considered sufficient in lieu of time averaging for occupational personnel in the areas in which the occupational exposure limit is exceeded.

(iv) **Category Four – WARNING/DANGER:** In addition to the mitigation actions required within those areas designated as Category Three, “WARNING” signs with the associated color (orange) are required where the occupational limit is exceeded by a factor of ten, and “DANGER” signs with the associated color (red) are required where immediate and serious injury will occur on contact. Signs must contain the components discussed in paragraph (b)(2)(v) of this section. If the boundaries between Category Three and Four are such that placement of both Category Three and Four signs would be in the same location, then the Category Three sign is optional. If power reduction, and therefore Category reduction, is not feasible, then lockout/tagout procedures in 29 CFR § 1910.147 must be followed.

(v) RF exposure advisory signs must include at least the following five components:

- (A) Appropriate signal word and associated color (*i.e.*, “DANGER” (red), “WARNING” (orange), “CAUTION,” (yellow) “NOTICE” (blue)} in accord with IEEE Std C95.2-1999, “IEEE Standard for Radio-Frequency Energy and Current-Flow Symbols,” copyright 1999 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017
- (B) RF energy advisory symbol (Figure A.3 of IEEE Std C95.2-1999)
- (C) An explanation of the RF source
- (D) Behavior necessary to comply with the exposure limits
- (E) Contact information

(3) In general, when the exposure limits specified in § 1.1310 are exceeded in an accessible area due to the emissions from multiple fixed RF sources, actions necessary to bring the area into compliance or preparation of an Environmental Assessment as specified in § 1.1311 are the shared responsibility of all licensees whose RF sources produce, at the area in question, levels that exceed 5% of the applicable exposure limit. Field strengths must be squared to be proportional to SAR or power density.

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Specifically, these compliance requirements apply if the square of the electric or magnetic field strength exposure level applicable to a particular RF source exceeds 5% of the square of the electric or magnetic field strength limit at the area in question where the levels due to multiple fixed RF sources exceed the exposure limit. Site owners and managers are expected to allow applicants and licensees to take reasonable steps to comply with the requirements contained in § 1.1307(b) and, where feasible, should encourage co-location of RF sources and common solutions for controlling access to areas where the RF exposure limits contained in § 1.1310 might be exceeded. Additionally, applicants for proposed RF sources and applicants for renewal of licenses for RF sources shall inform other licensees at a site in question of evaluations indicating possible non-compliance with the exposure limits.

(i) Applicants for proposed RF sources that would cause non-compliance with the limits specified in § 1.1310 at an accessible area previously in compliance must submit an EA if emissions from the applicant's RF source would produce, at the area in question, levels that exceed 5% of the applicable exposure limit. Field strengths must be squared if necessary to be proportional to SAR or power density.

(ii) Renewal applicants whose RF sources would cause non-compliance with the limits specified in § 1.1310 at an accessible area previously in compliance must submit an EA if emissions from the applicant's RF source would produce, at the area in question, levels that exceed 5% of the applicable exposure limit. Field strengths must be squared if necessary to be proportional to SAR or power density.

* * * * *

3. Section 1.1310 is amended to read as follows:

§ 1.1310 Radiofrequency radiation exposure limits.

(a) Specific absorption rate (SAR) shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in § 1.1307(b) within the frequency range of 100 kHz to 6 GHz (inclusive).

(b) The SAR limits for occupational/controlled exposure are 0.4 W/kg, as averaged over the whole body, and a peak spatial-average SAR of 8 W/kg, averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the parts of the human body treated as extremities, such as hands, wrists, feet, ankles, and pinnae, where the peak spatial-average SAR limit for occupational/controlled exposure is 20 W/kg, averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). Exposure may be averaged over a time period not to exceed 6 minutes to determine compliance with occupational/controlled SAR limits.

(c) The SAR limits for general population/uncontrolled exposure are 0.08 W/kg, as averaged over the whole body, and a peak spatial-average SAR of 1.6 W/kg, averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the parts of the human body treated as extremities, such as hands, wrists, feet, ankles, and pinnae, where the peak spatial-average SAR limit is 4 W/kg, averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). Exposure may be averaged over a time period not to exceed 30 minutes to determine compliance with general population/uncontrolled SAR limits.

(d)(1) Evaluation with respect to the SAR limits in this section must demonstrate compliance with both the whole-body and peak spatial-average limits using technically supported measurement or computational methods and exposure conditions in advance of authorization (licensing or equipment certification) and in a manner that facilitates enforcement. Numerical computation of SAR must be supported by adequate documentation showing that the numerical method as implemented in the computational software has been

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fully validated; in addition, the equipment under test and exposure conditions must be modeled according to protocols established by numerical computation standards or available FCC procedures for the specific computational method.

(2) For operation within the frequency range of 300 kHz and 6 GHz (inclusive), the limits for maximum permissible exposure (MPE), derived from whole-body SAR limits and listed in Table 1 of paragraph (e) of this section, may be used instead of whole-body SAR limits as set forth in paragraph (a) through (c) of this section to evaluate the environmental impact of human exposure to RF radiation as specified in § 1.1307(b), except for portable devices as defined in § 2.1093 as these evaluations shall be performed according to the SAR provisions in § 2.1093 of this chapter.

(3) At operating frequencies above 6 GHz, the MPE limits listed in Table 1 of paragraph (e) of this section shall be used in all cases to evaluate the environmental impact of human exposure to RF radiation as specified in § 1.1307(b).

(4) Both the MPE limits listed in Table 1 of paragraph (e) of this section and the SAR limits as set forth in paragraph (a) through (c) of this section are for continuous exposure, that is, for indefinite time periods. Exposure levels higher than the limits are permitted for shorter exposure times, as long as the average exposure over the specified averaging time in Table 1 is less than the exposure limits. Detailed information on our policies regarding procedures for evaluating compliance with all of these exposure limits can be found in the most current edition of FCC's *OET Bulletin 65*, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields," and its supplements, all available at the FCC's Internet Web site: <http://www.fcc.gov/oet/rfsafety>.

Note to Paragraphs (a) through (d): SAR is a measure of the rate of energy absorption due to exposure to RF electromagnetic energy. These SAR limits to be used for evaluation are based generally on criteria published by the American National Standards Institute (ANSI) for localized SAR in Section 4.2 of "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," ANSI/IEEE Std C95.1-1992, copyright 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," NCRP Report No. 86, Section 17.4.5, copyright 1986 by NCRP, Bethesda, Maryland 20814. Limits for whole body SAR and peak spatial-average SAR are based on recommendations made in both of these documents. The MPE limits in Table 1 are based generally on criteria published by the NCRP in "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," NCRP Report No. 86, Sections 17.4.1, 17.4.1.1, 17.4.2 and 17.4.3, copyright 1986 by NCRP, Bethesda, Maryland 20814. In the frequency range from 100 MHz to 1500 MHz, these MPE exposure limits for field strength and power density are also generally based on criteria recommended by the ANSI in Section 4.1 of "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," ANSI/IEEE Std C95.1-1992, copyright 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017.

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(e) Table 1 below sets forth limits for Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic fields.

Table 1—Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f ²)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f ²)	30
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

(1) Occupational/controlled exposure limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when a person is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure. The phrase *fully aware* in the context of applying these exposure limits means that an exposed person has received written and/or verbal information fully explaining the potential for RF exposure resulting from his or her employment. With the exception of *transient* persons, this phrase also means that an exposed person has received appropriate training regarding work practices relating to controlling or mitigating his or her exposure. See § 1.1307(b)(2) of this chapter. The phrase *exercise control* means that an exposed person is allowed and also knows how to reduce or avoid exposure by administrative or engineering work practices, such as use of personal protective equipment or time averaging of exposure.

(2) General population/uncontrolled exposure limits apply in situations in which the general public may be exposed, or in which persons who are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure. For example, RF sources intended for consumer use shall be subject to the limits for general population/uncontrolled exposure in this section.

* * * * *

4. Section 1.4000(c) is deleted.

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PART 2 – FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS

5. The authority citation for Part 2 continues to read as follows:

Authority: 47 U.S.C. 154, 302a, 303, and 336, unless otherwise noted.

6. Section 2.1091 is amended by revising paragraphs (b), (c), (d)(1), and (d)(2) to read as follows:

§ 2.1091 Radiofrequency radiation exposure evaluation: mobile devices.

* * * * *

(b) For purposes of this section, a mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons. In this context, the term “fixed location” means that the device is physically secured at one location and is not able to be easily moved to another location while transmitting. Transmitting devices designed to be used by consumers or workers that can be easily re-located, such as wireless devices associated with a personal desktop computer, are considered to be mobile devices if they meet the 20 centimeter separation requirement.

(c) Evaluation of compliance with the exposure limits in § 1.1310 of this chapter, and preparation of an EA if the limits are exceeded, is necessary for mobile devices with single RF sources either more than an available maximum time-averaged power of 1 mW or more than the ERP listed in Table 1 of § 1.1307(b)(1)(i), whichever is greater. For mobile devices not exempt by § 1.1307(b)(1)(i) at distances from 20 to 40 centimeters and frequencies from 0.3 to 6 GHz, evaluation of compliance with the exposure limits in § 1.1310 of this chapter is necessary if the ERP of the device is greater than ERP_{20cm} in the formula below. If the ERP of a single RF source at distances from 20 to 40 centimeters and frequencies from 0.3 to 6 GHz is not easily obtained, then the available maximum time-averaged RF output power may be used (*i.e.*, without consideration of ERP) in comparison with the formula below only if the device antenna(s) or radiating structure(s) do not exceed the electrical length of $\lambda/4$.

$$ERP_{20cm} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

(1) For multiple mobile RF sources within a device operating in the same time averaging period, when all transmitting antennas are at a separation distance of at least 20 centimeters, evaluation is required if:

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \frac{\sum_{j=1}^b SAR_j}{1.6 \text{ W/kg}} + \sum_{k=1}^c \frac{ERP_k}{ERP_{th,k}} \geq 1$$

Where

- a = number of mobile transmitters that use P_{th} , including existing transmitters and those being added.
- b = number of existing mobile transmitters with known SAR.
- c = number of mobile transmitters using ERP, according to either § 1.1307(b)(1)(i) or § 1.1307(b)(1)(ii) of this chapter, including existing transmitters and those being added.
- P_i = the available maximum time-averaged power or the ERP, whichever is greater, for mobile transmitter i.

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- $P_{th,i}$ = the threshold power according to the formula in § 1.1307(b)(1)(ii) of this chapter for mobile transmitter i.
- SAR_j = the maximum SAR reported for equipment certification from the j^{th} mobile transmitter in the device.
- ERP_k = ERP of mobile transmitter k.
- $ERP_{th,k}$ = exemption threshold ERP for mobile transmitter k, either according to § 1.1307(b)(1)(ii) of this chapter or § 1.1307(b)(1)(i) of this chapter, as applicable.

(2) For multiple mobile or portable RF sources within a device operating in the same time averaging period, routine environmental evaluation is required if the formula in § 2.1093(c)(2) of this chapter is applied to determine the exemption ratio and the result is greater than or equal to 1.

(3) Unless otherwise specified in this chapter, any other single mobile or multiple mobile and portable RF source(s) associated with a device is exempt from routine environmental evaluation for RF exposure prior to equipment authorization or use, except as specified in §§ 1.1307(c) and 1.1307(d) of this chapter.

(d) Applications for equipment authorization of mobile transmitting devices subject to routine environmental evaluation must contain a statement confirming compliance with the limits specified in § 1.1310 of this chapter as part of their application. Technical information showing the basis for this statement must be submitted to the Commission upon request. In general, maximum time-averaged power levels must be used for evaluation. All unlicensed personal communications service (PCS) devices and unlicensed NII devices shall be subject to the limits for general population/uncontrolled exposure.

(1) For purposes of analyzing mobile transmitting devices under the occupational/controlled criteria specified in § 1.1310 of this chapter, time averaging provisions of the limits may be used in conjunction with maximum duty factor to determine maximum time-averaged exposure levels under normal operating conditions.

(2) Such time averaging provisions based on maximum duty factor may not be used in determining exposure levels for devices intended for use by consumers in general population/uncontrolled environments as defined in § 1.1310 of this chapter. However, “source-based” time averaging based on an inherent property of the RF source is allowed. An example of this is the determination of exposure from a device that uses digital technology such as a time-division multiple-access (TDMA) scheme for transmission of a signal.

(3) * * *

(4) * * *

7. Section 2.1093 is amended by revising paragraphs (c) and (d) to read as follows:

§ 2.1093 Radiofrequency radiation exposure evaluation: portable devices.

* * * * *

(c) Evaluation of compliance with the exposure limits in § 1.1310 of this chapter, and preparation of an EA if the limits are exceeded, is necessary for portable devices with single RF sources with more than an available maximum time-averaged power of 1 mW, more than the ERP listed in Table 1 of § 1.1307(b)(1)(i), or more than the P_{th} in the formula below, whichever is greater. The formula below shall only be used in conjunction with portable devices not exempt by § 1.1307(b)(1)(i) at distances from 0.5 to

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20 centimeters and frequencies from 0.3 to 6 GHz. If the ERP of a single RF source at distances from 0.5 to 20 centimeters and frequencies from 0.3 to 6 GHz is not easily obtained, then available maximum time-averaged power may be used (*i.e.*, without consideration of ERP) in comparison with the formula below only if the device antenna(s) or radiating structure(s) do not exceed the electrical length of $\lambda/4$.

$$P_{th} \text{ (mW)} = ERP_{20cm} (d / 20 \text{ cm})^x$$

Where

$$x = -\log_{10} \left(\frac{60}{ERP_{20cm} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}$$

$$ERP_{20cm} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

d = the minimum separation distance in any direction from any part of the device antenna(s) or radiating structure(s) to the body of the device user

(1) For multiple portable RF sources within a device operating in the same time averaging period, when all transmitting antennas are at a separation distance of up to 20 centimeters, evaluation is required if:

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \frac{\sum_{j=1}^b SAR_j}{1.6 \text{ W/kg}} + \sum_{k=1}^c \frac{ERP_k}{ERP_{th,k}} \geq 1$$

Where

a = number of portable transmitters that use P_{th} , including existing transmitters and those being added.

b = number of existing portable transmitters with known SAR.

c = number of portable transmitters using ERP, according to either § 1.1307(b)(1)(i) or § 1.1307(b)(1)(ii) of this chapter, including existing transmitters and those being added.

P_i = the available maximum time-averaged power or the ERP, whichever is greater, for portable transmitter i .

$P_{th,i}$ = the threshold power according to the formula in § 1.1307(b)(1)(ii) of this chapter for portable transmitter i .

SAR_j = the maximum SAR reported for equipment certification from the j^{th} portable transmitter in the device.

ERP_k = ERP of portable transmitter k .

$ERP_{th,k}$ = exemption threshold ERP for portable transmitter k , either according to § 1.1307(b)(1)(ii) of this chapter or § 1.1307(b)(1)(i) of this chapter, as applicable.

(2) For multiple mobile or portable RF sources within a device operating in the same time averaging period, evaluation is required if:

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \frac{\sum_{j=1}^b SAR_j}{1.6 \text{ W/kg}} + \sum_{k=1}^c \frac{ERP_k}{ERP_{th,k}} \geq 1$$

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Where

- a = number of mobile or portable transmitters that use P_{th} , including existing transmitters and those being added.
- b = number of existing mobile or portable transmitters with known SAR.
- c = number of mobile or portable transmitters using ERP, according to either § 1.1307(b)(1)(i) or § 1.1307(b)(1)(ii) of this chapter, including existing transmitters and those being added.
- P_i = the available maximum time-averaged power or the ERP, whichever is greater, for mobile or portable transmitter i.
- $P_{th,i}$ = the threshold power according to the formula in § 1.1307(b)(1)(ii) of this chapter for mobile or portable transmitter i.
- SAR_j = the maximum SAR reported for equipment certification from the j^{th} mobile or portable transmitter in the device.
- ERP_k = ERP of mobile or portable transmitter k.
- $ERP_{th,k}$ = exemption threshold ERP for mobile or portable transmitter k, either according to § 1.1307(b)(1)(ii) of this chapter or § 1.1307(b)(1)(i) of this chapter, as applicable.

(3) Unless otherwise specified in this chapter, any other single portable or multiple mobile and portable RF source(s) associated with a device is exempt from routine environmental evaluation for RF exposure prior to equipment authorization or use, except as specified in §§ 1.1307(c) and 1.1307(d) of this chapter.

(d) Applications for equipment authorization of portable transmitting devices subject to routine environmental evaluation must contain a statement confirming compliance with the limits specified in § 1.1310 of this chapter as part of their application. The limits to be used for evaluation shall apply for portable devices transmitting in the frequency range from 100 kHz to 6 GHz in terms of the SAR limits specified in §§ 1.1310(a) through (c) of this chapter. The device must be evaluated at a separation distance applicable to the operating configurations and exposure conditions of the device. Portable devices that transmit at frequencies above 6 GHz are to be evaluated in terms of the MPE limits specified in Table 1 of § 1.1310(e) of this chapter. Technical information showing the basis for this statement must be submitted to the Commission upon request. In general, maximum time-averaged power levels must be used for evaluation. All unlicensed personal communications service (PCS) devices and unlicensed NII devices shall be subject to the limits for general population/uncontrolled exposure.

(1) Evaluation of compliance with the SAR limits can be demonstrated by either laboratory measurement techniques or by computational modeling. The latter must be supported by adequate documentation showing that the numerical method as implemented in the computational software has been fully validated; in addition, the equipment under test and exposure conditions must be modeled according to protocols established by numerical computation standards or available FCC procedures for the specific computational method. Guidance regarding SAR measurement techniques can be found in the Office of Engineering and Technology (OET) Laboratory Division Knowledge Database (KDB). The staff guidance provided in the KDB does not necessarily represent the only acceptable methods for measuring RF exposure or emissions, and is not binding on the Commission or any interested party.

(2) For purposes of analyzing portable transmitting devices under the occupational/controlled SAR criteria specified in § 1.1310 of this chapter, the time averaging provisions of these SAR criteria may be used to determine maximum time-averaged exposure levels under normal operating conditions.

(3) The time averaging provisions for occupational/controlled SAR criteria, based on maximum duty factor, may not be used in determining typical exposure levels for portable devices intended for use

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by consumers, such as cellular telephones, that are considered to operate in general population/uncontrolled environments as defined in § 1.1310 of this chapter. However, “source-based” time averaging based on an inherent property of the RF source is allowed. An example of this would be the determination of exposure from a device that uses digital technology such as a time-division multiple-access (TDMA) scheme for transmission of a signal.

(4) Visual advisories (such as labeling, embossing, or on an equivalent electronic display) on portable devices designed only for occupational use can be used as part of an applicant’s evidence of the device user’s awareness of occupational/controlled exposure limits. Such visual advisories shall be legible and clearly visible to the user from the exterior of the device. Visual advisories must indicate that the device is for occupational use only, refer the user to specific information on RF exposure, such as that provided in a user manual and note that the advisory and its information is required for FCC RF exposure compliance. Such instructional material must provide the user with information on how to use the device in order to ensure compliance with the occupational/controlled exposure limits. A sample of the visual advisory, illustrating its location on the device, and any instructional material intended to accompany the device when marketed, shall be filed with the Commission along with the application for equipment authorization. Details of any special training requirements pertinent to limiting RF exposure should also be submitted. Holders of grants for portable devices to be used in occupational settings are encouraged, but not required, to coordinate with end-user organizations to ensure appropriate RF safety training.

(5) General population/uncontrolled exposure limits defined in § 1.1310 of this chapter apply to portable devices intended for use by consumers or persons who are exposed as a consequence of their employment and may not be fully aware of the potential for exposure or cannot exercise control over their exposure. No communication with the consumer including either visual advisories or manual instructions will be considered sufficient to allow consumer portable devices to be evaluated subject to limits for occupational/controlled exposure specified in § 1.1310 of this chapter.

PART 15 – RADIO FREQUENCY DEVICES

8. The authority citation for Part 15 continues to read as follows:

Authority: 47 U.S.C. 154, 302a, 303, 304, 307, 336, and 544a.

9. Section 15.709(d) is amended to read as follows:

* * * * *

(d) *Compliance with radio frequency exposure requirements.* TVBDs shall ensure compliance with the Commission's radio frequency exposure requirements in §§ 1.1307(b), 2.1091 and 2.1093 of this chapter, where applicable.

PART 24 – PERSONAL COMMUNICATIONS SERVICES

10. The authority citation for Part 24 continues to read as follows:

Authority: 47 U.S.C. 154, 301, 302, 303, 309 and 332.

11. Section 24.51(c) is deleted and reserved.

12. Section 24.52 is amended to read as follows:

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§ 24.52 RF exposure.

Licensees and manufacturers shall ensure compliance with the Commission's radio frequency exposure requirements in § 1.1307(b) of this chapter. An environmental assessment may be required if RF radiation from the proposed facilities would, in combination with radiation from other sources, cause RF power density or field strength in an accessible area to exceed the applicable limits specified in § 1.1310 of this chapter. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.

PART 25 – SATELLITE COMMUNICATIONS

13. The authority citation for Part 25 continues to read as follows:

Authority: 47 U.S.C. 701–744. Interprets or applies Sections 4, 301, 302, 303, 307, 309 and 332 of the Communications Act, as amended, 47 U.S.C. Sections 154, 301, 302, 303, 307, 309 and 332, unless otherwise noted.

14. Section 25.115(j) is amended to read as follows:

§ 25.115 Application for earth station authorizations.

* * * * *

(j) The licensee and grantees shall ensure compliance with the Commission's radio frequency exposure requirements in § 1.1307(b) of this chapter. An environmental assessment may be required if RF radiation from the proposed facilities would, in combination with radiation from other sources, cause RF power density or field strength in an accessible area to exceed the applicable limits specified in § 1.1310 of this chapter. See § 1.1307(b)(3)(i).

15. Section 25.117(g) is amended to read as follows:

* * * * *

(g) The licensee and grantees shall ensure compliance with the Commission's radio frequency exposure requirements in § 1.1307(b) of this chapter. An environmental assessment may be required if RF radiation from the proposed facilities would, in combination with radiation from other sources, cause RF power density or field strength in an accessible area to exceed the applicable limits specified in § 1.1310 of this chapter. See § 1.1307(b)(3)(ii).

16. Section 25.129(c) is amended to read as follows:

* * * * *

(c) In addition to the information required by § 2.1033(c) of this chapter, applicants for certification required by this section shall submit any additional equipment test data necessary to demonstrate compliance with pertinent standards for transmitter performance prescribed in § 25.138, § 25.202(f), § 25.204, § 25.209, and § 25.216, and shall ensure compliance with the Commission's radio frequency exposure requirements in § 1.1307(b) of this chapter. An environmental assessment may be required if RF radiation from the proposed facilities would, in combination with radiation from other sources, cause RF power density or field strength in an accessible area to exceed the applicable limits specified in § 1.1310 of this chapter. Applications for equipment authorization of mobile or portable devices operating

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under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.

(d) * * *

17. Section 25.149(c)(3) is amended to read as follows:

* * * * *

(c) * * *

(1) * * *

(2) * * *

(3) Licensees and manufacturers shall ensure compliance with the Commission's radio frequency exposure requirements in § 1.1307(b) of this chapter. An environmental assessment may be required if RF radiation from the proposed facilities would, in combination with radiation from other sources, cause RF power density or field strength in an accessible area to exceed the applicable limits specified in § 1.1310 of this chapter. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.

* * * * *

18. Section 25.226(b)(8) is amended to read as follows:

* * * * *

(b) * * *

(1) * * *

(2) * * *

(3) * * *

(4) * * *

(5) * * *

(6) * * *

(7) * * *

(8) All VMES applicants shall ensure compliance with the Commission's radio frequency exposure requirements in § 1.1307(b) of this chapter. An environmental assessment may be required if RF radiation from the proposed facilities would, in combination with radiation from other sources, cause RF power density or field strength in an accessible area to exceed the applicable limits specified in § 1.1310 of this chapter. VMES applicants with VMES terminals that will exceed the guidelines in § 1.1310 of this chapter for radio frequency radiation exposure shall provide, with their environmental

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assessment, a plan for mitigation of radiation exposure to the extent required to meet those guidelines. All VMES licensees shall ensure installation of VMES terminals on vehicles by qualified installers who have an understanding of the antenna's radiation environment and the measures best suited to maximize protection of the general public and persons operating the vehicle and equipment. A VMES terminal exhibiting radiation exposure levels exceeding 1.0 mW/cm^2 in accessible areas, such as at the exterior surface of the radome, shall have a label attached to the surface of the terminal warning about the radiation hazard and shall include thereon a diagram showing the regions around the terminal where the radiation levels could exceed 1.0 mW/cm^2 . All VMES applicants shall demonstrate that their VMES terminals are capable of automatically ceasing transmissions upon the loss of synchronization or within 5 seconds of loss of reception of the satellite downlink signal, whichever is the shorter timeframe.

* * * * *

PART 27 – MISCELLANEOUS WIRELESS COMMUNICATIONS SERVICES

19. The authority citation for Part 27 continues to read as follows:

Authority: 47 U.S.C. 154, 301, 302, 303, 307, 309, 332, 336, and 337 unless otherwise noted.

20. Section 27.52 is amended to read as follows:

§ 27.52 RF exposure.

Licensees and manufacturers shall ensure compliance with the Commission's radio frequency exposure requirements in § 1.1307(b) of this chapter. An environmental assessment may be required if RF radiation from the proposed facilities would, in combination with radiation from other sources, cause RF power density or field strength in an accessible area to exceed the applicable limits specified in § 1.1310 of this chapter. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.

PART 73 – RADIO BROADCAST SERVICES

21. The authority citation for Part 73 continues to read as follows:

Authority: 47 U.S.C. 154, 303, 334, 336, and 339.

22. Section 73.404(e)(10) is amended to read as follows:

* * * * *

(e) * * *

(1) * * *

(2) * * *

(3) * * *

(4) * * *

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(5) * * *

(6) * * *

(7) * * *

(8) * * *

(9) * * *

(10) Licensees and permittees shall ensure compliance with the Commission's radio frequency exposure requirements in § 1.1307(b) of this chapter. An environmental assessment may be required if RF radiation from the proposed facilities would, in combination with radiation from other sources, cause RF power density or field strength in an accessible area to exceed the applicable limits specified in § 1.1310 of this chapter.

PART 90 – PRIVATE LAND MOBILE RADIO SERVICES

23. The authority citation for Part 90 continues to read as follows:

Authority: Sections 4(i), 11, 303(g), 303(r), and 332(c)(7) of the Communications Act of 1934, as amended, 47 U.S.C. 154(i), 161, 303(g), 303(r), 332(c)(7).

24. Section 90.1217 is amended to read as follows:

§ 90.1217 RF exposure.

Licensees and manufacturers shall ensure compliance with the Commission's radio frequency exposure requirements in § 1.1307(b) of this chapter. An environmental assessment may be required if RF radiation from the proposed facilities would, in combination with radiation from other sources, cause RF power density or field strength in an accessible area to exceed the applicable limits specified in § 1.1310 of this chapter. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.

PART 95 – PERSONAL RADIO SERVICES

25. The authority citation for Part 95 continues to read as follows:

Authority: Secs. 4, 303, 48 Stat. 1066, 1082, as amended; 47 U.S.C. 154, 303.

26. Section 95.628(h) is amended to read as follows:

§ 95.628 MedRadio transmitters.

* * * * *

(h) *Measurement procedures.*

(1) MedRadio transmitters shall be tested for frequency stability, radiated emissions and EIRP limit compliance in accordance with paragraphs (h)(2) and (h)(3) of this section.

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(2) Frequency stability testing shall be performed over the temperature range set forth in (f) of this section.

(3) Radiated emissions and EIRP measurements may be determined by measuring the radiated field from the equipment under test at 3 meters and calculating the EIRP. The equivalent radiated field strength at 3 meters for 1 milliwatt, 25 microwatts, 250 nanowatts, and 100 nanowatts EIRP is 115.1, 18.2, 1.8, or 1.2 mV/meter, respectively, when measured on an open area test site; or 57.55, 9.1, 0.9, or 0.6 mV/meter, respectively, when measured on a test site equivalent to free space such as a fully anechoic test chamber. Compliance with the maximum transmitter power requirements set forth in § 95.639(f) shall be based on measurements using a peak detector function and measured over an interval of time when transmission is continuous and at its maximum power level. In lieu of using a peak detector function, measurement procedures that have been found to be acceptable to the Commission in accordance with §2.947 of this chapter may be used to demonstrate compliance.

(i) For a transmitter intended to be implanted in a human body, radiated emissions and EIRP measurements for transmissions by stations authorized under this section may be made in accordance with a Commission-approved human body simulator and test technique. The reference to be used for dielectric properties of the tissue-equivalent material for the body simulator is in 2.1093(d)(1) of this chapter.

27. Section 95.1125 is amended to read as follows:

§ 95.1125 RF exposure.

Portable devices as defined in §2.1093(b) of this chapter operating in the WMTS shall ensure compliance with the Commission's radio frequency exposure requirements in § 1.1307(b) of this chapter. An environmental assessment may be required if RF radiation from the proposed facilities would, in combination with radiation from other sources, cause RF power density or field strength in an accessible area to exceed the applicable limits specified in § 1.1310 of this chapter. Applications for equipment authorization of WMTS devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.

28. Section 95.1221 is amended to read as follows:

§ 95.1221 RF exposure.

A MedRadio medical implant device or medical body-worn transmitter is subject to the radiofrequency radiation exposure requirements specified in §§ 1.1307(b) and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of devices operating under this section must demonstrate compliance with these requirements using either computational modeling or laboratory measurement techniques. Where a showing is based on computational modeling, the Commission retains the discretion to request that supporting documentation and/or specific absorption rate (SAR) measurement data be submitted, as described in 2.1093(d)(1).

PART 97 – AMATEUR RADIO SERVICE

29. The authority citation for Part 97 continues to read as follows:

Authority: 48 Stat. 1066, 1082, as amended; 47 U.S.C. 154, 303. Interpret or apply 48 Stat. 1064–1068, 1081–1105, as amended; 47 U.S.C. 151–155, 301–609, unless otherwise noted.

30. Section 97.13 is amended to read as follows:

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* * * * *

(c) * * *

(1) The licensee shall ensure compliance with the Commission's radio frequency exposure requirements in §§ 1.1307(b), 2.1091 and 2.1093 of this chapter, where applicable. In lieu of evaluation with the general population/uncontrolled exposure limits, amateur licensees may evaluate their operation with respect to members of his or her immediate household using the occupational/controlled exposure limits in § 1.1310, provided appropriate training and information has been supplied to the amateur licensee and members of his/her household. Other nearby persons who are not members of the amateur licensee's household must be evaluated with respect to the general population/uncontrolled exposure limits. Appropriate methodologies and guidance for evaluating amateur radio service operation is described in the Office of Engineering and Technology (OET) Bulletin 65, Supplement B.

(2) * * *

PART 101 – FIXED MICROWAVE SERVICE

31. The authority citation for Part 101 continues to read as follows:

Authority: 47 U.S.C. 154, 303.

32. Section 101.1425 is amended to read as follows:

§ 101.1425 RF exposure.

MVDDS stations in the 12.2–12.7 GHz frequency band shall ensure compliance with the Commission's radio frequency exposure requirements in § 1.1307(b) of this chapter. An environmental assessment may be required if RF radiation from the proposed facilities would, in combination with radiation from other sources, cause RF power density or field strength in an accessible area to exceed the applicable limits specified in § 1.1310 of this chapter.

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APPENDIX C

Derivation of General MPE-Based Exemption from RF Evaluation for Single RF Sources

1. FCC Limits for General Population/Uncontrolled Maximum Permissible Exposure (MPE)

The FCC's maximum permissible exposure (MPE) limits for radiofrequency (RF) electromagnetic energy are given in section 1.1310 of the FCC's rules. The following table illustrates the general population/uncontrolled exposure limits. As can readily be seen, these limits can be divided into five broad frequency ranges. The exposure limits for bands (2) and (4) vary with frequency, while bands (1), (3) and (5) are fixed values.

Frequency Band	Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(1)	0.3–1.34	614	1.63	*(100)	30
(2)	1.34–30	824/f	2.19/f	*(180/f ²)	30
(3)	30–300	27.5	0.073	0.2	30
(4)	300–1500			f/1500	30
(5)	1500–100,000			1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

2. Basis for Exemptions from Routine Evaluation

Table 1 defining exemption criteria for single RF sources proposed in the *Further Notice* for section 1.1307(b) is reproduced below. The values in this table were derived for effective radiated power (ERP) depending on separation distance (and frequency for bands (2) and (4)) using the MPE exposure limits of section 1.1310 for general population/uncontrolled and far-field calculations for each of the five frequency bands noted above. This conservative derivation is assumed to be worst-case due to the use of 100% reflection in the far-field of the main-beam. The rationale for this derivation is that if these conservative ERP and separation distance exemption criteria are met then there is minimal likelihood for the exposure limits for the general public to be exceeded.

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Table 1—Single RF Sources Subject to Routine Environmental Evaluation

Transmitter Frequency (MHz)	Threshold ERP (watts)
Regardless of ERP, evaluation is required if the separation distance R is less than $\lambda/2\pi$ from the radiating structure, where λ is the free-space operating wavelength, unless the available maximum time-averaged power is less than one milliwatt. In addition, evaluation is required if the ERP in watts is greater than the value given by the formula below for the appropriate frequency f in MHz at the separation distance R in meters.	
0.3 – 1.34	$ERP \geq 1,920 R^2$
1.34 – 30	$ERP \geq 3,450 R^2/f^2$
30 – 300	$ERP \geq 3.83 R^2$
300 – 1,500	$ERP \geq 0.0128 R^2 f$
1,500 – 100,000	$ERP \geq 19.2 R^2$

In the context of Table 1 above, the ERP is defined as the product of the maximum antenna gain and the delivered maximum time-averaged power summed over all polarizations, the term “maximum antenna gain” is the largest far-field total power gain relative to a dipole in any direction for all transverse polarization components, and the term “delivered maximum time-averaged power” is the largest net power delivered or supplied to the antenna as averaged over any 30 minute time period for fixed sources and as averaged over a period inherent from device transmission characteristics for mobile and portable sources. The term “separation distance” in Table 1 is defined as the minimum distance in any direction from any part of the radiating structure of a transmitting antenna or antenna array to the body of a nearby person. To the extent that $R \geq \lambda/2\pi$, the proposed criteria in Table 1 above may be applied to fixed, mobile, or portable RF sources.

While these conditions are conservative in the radiating near-field they may not be conservative in the reactive near-field. Thus, for exposure within the “radiansphere”¹ where $R < \lambda/2\pi$ where this could be a concern further evaluation is required. Reactive near fields generally dominate at separation distances of less than $\lambda/2\pi$ and may be stronger than the fields calculated based on the far-field gain, particularly in the case of electrically short antennas. “[F]or distances beyond $\lambda/2\pi$ the electric field varies as $1/r$... which corresponds to the classical far field. For sufficiently [electrically] short dipoles at distances less than $\lambda/2\pi$ the field [theoretically] varies [as much] as $1/r^3$... and this comprises the so called near field or reactive zone of the antenna.”² This behavior is a characteristic of any differential dipole element that may exist anywhere in the radiating structure. For example, the tips of a half-wave dipole have electric fields that increase more rapidly than $1/r$ at less than $\lambda/2\pi$. Therefore, the separation distance is defined as above to be from any part of the radiating structure of a transmitting antenna.

For far-field conditions, a worst-case estimate for power density with 100% reflection of incoming radiation (OET Bulletin 65 equation (6)) can be calculated from the following general equation:

¹ Proceedings of the IRE, *The Radiansphere Around a Small Antenna*, Wheeler, Harold A., 1959.

² Environmental Protection Agency, *Near-Field Radiation Properties of Simple Linear Antennas with Applications to Radiofrequency Hazards and Broadcasting*, Tell, Richard A., ORP/EAD 78-4, June 1978.

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$$S = \frac{2^2 PG}{4\pi R^2} = \frac{2^2 EIRP}{4\pi R^2} = \frac{(2^2)1.64ERP}{4\pi R^2}$$

Where S = power density (W/m^2), P = power (W), G = antenna gain, and R = distance (m).

Solving for ERP in the above equation, $ERP = \frac{\pi SR^2}{1.64}$.

Substituting the value for S from the MPE exposure limits allows for the derivation of these MPE-based exemption criteria, as discussed in further detail below.

It is likely that operation in frequency band (1) will require evaluation due to the magnitude of $\lambda/2\pi$ in this frequency band, because from 0.3 MHz to 1.34 MHz evaluation is required if the separation distance is less than $\lambda/2\pi$, which ranges across the band from 159 meters to 35.6 meters, respectively. The most restrictive (general population/uncontrolled) exposure limit in this frequency band is a constant value of 1000 W/m^2 . The antennas most commonly used for transmitting at these frequencies are AM monopole towers. Evaluation for these facilities can be facilitated through the use of Bulletin 65 Supplement A, and most licensees in this band should already be aware of this obligation. A worst-case approximation for maximum ERP dependent on separation distance can be derived for these frequencies based on the far-field equation with 100% reflection. Thus, maximum ERP can be obtained according to:

$$ERP = 1920 R^2$$

From 1.34 MHz to 30 MHz (frequency band (2)) evaluation is required if the separation distance is less than $\lambda/2\pi$, which ranges across the band from 35.6 meters to 1.59 meters, respectively, and the general population exposure limit varies according to the inverse square of the frequency as follows:

$$\text{Exposure limit (power density)} = \frac{1800}{f^2} \text{ W/m}^2 \quad \text{where } f \text{ is frequency in MHz.}$$

Using the far-field equation, maximum ERP can be obtained according to:

$$ERP = 3450 \frac{R^2}{f^2}$$

From 30 to 300 MHz (frequency band (3)) evaluation is required if the separation distance is less than $\lambda/2\pi$, which ranges across the band from 1.59 meters to 0.159 meters, respectively. In this band, the general population exposure limit is a constant value (2 W/m^2). Using the far-field equation, maximum ERP can be obtained according to:

$$ERP = 3.83 R^2$$

From 300 to 1,500 MHz (frequency band (4)) evaluation is required if the separation distance is less than $\lambda/2\pi$, which ranges across the band from 159 mm to 31.8 mm, respectively and the general population exposure limit varies according to frequency as follows:

$$\text{Exposure limit (power density)} = \frac{f}{150} \text{ W/m}^2 \quad \text{where } f \text{ is frequency in MHz.}$$

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Using the far-field equation, maximum ERP can be obtained according to:

$$ERP = 0.0128 R^2 f$$

From 1500 MHz to 100 GHz (frequency band (5)) evaluation is required if the separation distance is less than $\lambda/2\pi$, which ranges across the band from 31.8 mm to 0.48 mm, respectively. In this band, the general population exposure limit is a constant value of 10 W/m². Using the far-field equation, maximum ERP can be obtained according to:

$$ERP = 19.2 R^2$$

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APPENDIX D

Derivation of General SAR-Based Exemption From RF Evaluation for Single RF Sources

As a general approach the Commission in this *Further Notice* proposes to adopt frequency- and distance-dependent power thresholds. The purpose of this Appendix is to derive these frequency- and distance-dependent time-averaged power thresholds, below which single portable RF sources operating in the frequency range of 300 MHz (0.3 GHz) to 6 GHz may be exempt from RF evaluation. These thresholds are based on both the 1.6 W/kg SAR limit¹ and constant values for effective radiated power (ERP) using formulas derived from OET Bulletin 65 equation (5) at exactly 20 centimeters (cm) from the body. Here we ensure a conservative model with consideration of electrically small antennas with practical bandwidths.²

The strategy in developing the exemption thresholds is to separate the frequency dependence from the distance dependence of these thresholds in a two step process. Briefly, first we approximate a frequency and conductivity obtained from OET Bulletin 65, Supplement C. Second, half-wave dipoles at a separation distance of approximately 2 cm are used to determine a constant multiplier (60) for the frequency dependence factor ($1/\sqrt{f}$) to derive power thresholds in mW. In deriving these power thresholds in mW, the associated units used are cm for distance and GHz for frequency. The distance dependence is then computed according to an exponential function between 2 and 20 cm using the threshold power found above at 2 cm and the constant values for ERP using the formulas derived in Appendix C (except also assuming no reflection from close objects) at exactly 20 cm. To test this simple model, half-wave dipoles and planar tissue half-spaces are used to verify the SAR versus distance and frequency relationship at the resulting power thresholds. The results of this model are verified by independent SAR computations and are found to be significantly less than the 1.6 W/kg 1-gram limit.

Due to the distance where $\lambda/2\pi$ is equal to 20 cm, the lowest frequency used for these power thresholds is 300 MHz. Separation distances less than $\lambda/2\pi$ are not allowed in the MPE-based exemption criteria due to the reactive near field, as discussed in Appendix C. Since $\lambda/2\pi$ is 20 cm at 239 MHz, the MPE-based exemption criteria cannot be used to exempt antennas operating below 239 MHz if the separation distance is 20 cm or less. For the case of portable RF sources where separation distance is defined to be less than 20 cm, the lowest frequency at which these SAR-based exemption criteria established herein are valid will be 0.3 GHz (using the conventional frequency breakpoint at 300 MHz), thereby avoiding violation of the $\lambda/2\pi$ requirement at 20 cm for the MPE-based exemption criteria.

Canonical sources such as resonant half-wave dipoles have been used extensively to simulate the field conditions required for various RF exposure investigations. In theory, electrically short antennas may have considerably higher SAR for a given power than the resonant half-wave dipoles used in this analysis, for example, electrically short dipoles that are as short as one-sixteenth wavelength with bandwidths of a few percent.³ Further, SAR values in practice for real devices are expected to be several times less and rarely more than half the SAR of resonant half-wave dipoles operating at the same power

¹ See 47 CFR § 2.1093(d)(2) (proposed § 1.1310).

² International Electrotechnical Commission, IEC 62479, Draft Edition 1, Distributed March 12, 2010.

³ Abu T. M. Sayem, et. al., *Correlating Threshold Power With Free-Space Bandwidth for Low-Directivity Antennas*, IEEE Trans. on Electromagnetic Compatibility, Vol. 51, No. 1, Feb 2009 25-37.

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as the device.⁴ However, necessary modifications that are required for some prototype devices to be compliant with SAR limits would not be required to undergo such modifications with inadequately restrictive exemption criteria.⁵ Based on these considerations, we propose that use of half-wave dipoles resulting in SAR values significantly less than 1.6 W/kg over 1-g is adequately conservative to ensure with reasonable certainty that the variety of real single portable RF sources having power less than the derived thresholds will have measured SAR values less than the specified limit. As shown in Table D-4, the maximum resultant 1-g SAR values occur at short distances and at higher frequencies, where there is less tendency to use electrically short antennas. Therefore, using resonant half-wave dipoles to model the expected SAR for RF sources should generally be conservative.

1. Derivation of ERP_{20cm}

Constant values are derived by defining a common value at exactly 20 cm without the use of 100% reflection in the far-field of the main-beam. There are two reasons for not considering 100% reflection in the derivation of these portable exemption criteria. First, the evaluation process for portable devices to determine compliance with our exposure limits does not involve an environment where a reflection would occur. A typical SAR measurement facility measures exposure from portable devices using a mannequin to test devices in normal use configurations to account for coupling concerns. Second, during the typical usage of portable devices, it is not likely that a perfect reflection would occur, since metallic objects are not expected to be near a device during normal use. Thus, using these exemption criteria, there is a low probability that the exposure limits for the general public could be exceeded. Using the formula in OET Bulletin 65 equation (5) (without 100% reflection), values at exactly 20 cm can be calculated as follows, accounting for appropriate unit conversion, where effective radiated power = ERP (mW), frequency = f (GHz), and separation distance = R (cm).

For “far-field” conditions, a worst-case estimate for power density without 100% reflection of incoming radiation (OET Bulletin 65 equation (5)) can be calculated from the following general equation

$$S = \frac{EIRP}{4\pi R^2} = \frac{1.64ERP}{4\pi R^2}, \text{ or } ERP = \frac{4\pi SR^2}{1.64}$$

The first relevant frequency band for these SAR-based exemption criteria is from 0.3 to 1.5 GHz.

$$ERP(\text{mW}) = \frac{4\pi(f/1.5)(20\text{ cm})^2}{1.64} \approx 2040f$$

The other frequency band for these SAR-based exemption criteria is from 1.5 GHz to 6 GHz.

$$ERP(\text{mW}) = \frac{4\pi(1.0)(20\text{ cm})^2}{1.64} \approx 3060$$

Thus, in summary, the ERP in the range of 0.3 to 6 GHz, at exactly 20 cm is:

⁴ Mohammad Ali, *et al.*, *Threshold Power of Canonical Antennas for Inducing SAR at Compliance in the 300-3000 MHz Frequency Range*, IEEE Trans. on Electromagnetic Compatibility, Vol. 49, No. 1, Feb 2007 143-152.

⁵ See APREL comments to Notice at 2; IT'IS comments to Notice at 3.

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$$ERP_{20cm} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

These values of ERP_{20cm} will be used in section 4 of this appendix in the exemption threshold formula for distances less than 20 cm.

2. Plane Wave Models

A plane uniform wave normally incident on a planar homogeneous tissue model enables the calculation of both localized and 1-gram average SAR for specific tissue dielectric properties and frequencies.⁶ The incident power densities are computed at 15 frequencies according to the head and body tissue dielectric parameters in OET Bulletin 65 Supplement C 01-01. The results are summarized in Tables D-1 and D-2. The power density can be computed within the 0.3 – 6 GHz range for both head and body tissue parameters according to the fitted function $S/\sqrt{f_{\text{(GHz)}}}$, where 5 has been estimated as the analytical power density value in Tables D-1 and D-2 at 1 GHz and the square root in the denominator is an approximation to fitted exponents near -0.5. Where a closer fit might be achieved by varying the approximated coefficient of 5, the only information used later in this appendix is the exponent of -0.5 for the frequency dependence.

Table D-1 - Plane Wave Power Density (mW/cm²) Computed for Head Tissues per W/kg (1-g SAR)

GHz	ϵ_r	σ (S/m)	analytical (mW/cm ²)	fitted (mW/cm ²)	difference %
0.3	45.3	0.87	8.01	9.13	14.0
0.45	43.5	0.87	6.75	7.45	10.4
0.835	41.5	0.9	5.66	5.47	-3.3
0.9	41.5	0.97	5.35	5.27	-1.4
0.915	41.5	0.98	5.30	5.23	-1.3
1.45	40.5	1.2	4.39	4.15	-5.4
1.61	40.3	1.29	4.15	3.94	-5.1
1.8	40	1.4	3.91	3.73	-4.5
1.9	40	1.4	3.89	3.63	-6.7
2	40	1.4	3.88	3.54	-8.7
2.45	39.2	1.8	3.30	3.19	-3.4
3	38.5	2.4	2.85	2.89	1.5
4.5	36.8	3.94	2.37	2.36	-0.5
5.2	35.4	4.66	2.26	2.19	-3.2
5.8	35.3	5.27	2.22	2.08	-6.4

⁶ See Niels Kuster and Quirino Balzano, *Energy Absorption Mechanisms by Biological Bodies in the Near Field of Dipole antennas Above 300 MHz*, IEEE Trans. on Vehicular Technology, Vol. 41, No. 1, Feb 1992. See also Gang Kang and Om P. Gandhi, *Effect of Dielectric Properties on the Peak 1- and 10-g SAR for 802.11 a/b/g Frequencies 2.45 and 5.15 to 5.85 GHz*, IEEE Trans. on Electromagnetic Compatibility, Vol. 46, No. 2, May 2004.

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Table D-2 - Plane Wave Power Density (mW/cm²) Computed for Body Tissues per W/kg (1-g SAR)

GHz	0.3	0.45	0.835	0.9	0.915	1.45	1.61	1.8	1.9	2	2.45	3	4.5	5.2	5.8
ϵ_r	58.2	56.7	55.2	55	55	54	53.8	53.3	53.3	53.3	52.7	52	50	49	48.2
σ (S/m)	0.92	0.94	0.97	1.05	1.06	1.3	1.4	1.52	1.52	1.52	1.95	2.73	4.48	5.3	6
analytical (mW/cm ²)	8.63	7.43	6.48	6.09	6.04	5.03	4.76	4.47	4.46	4.44	3.79	3.18	2.64	2.53	2.46
fitted (mW/cm ²)	9.13	7.45	5.47	5.27	5.23	4.15	3.94	3.73	3.63	3.54	3.19	2.89	2.36	2.19	2.08
difference %	5.8	0.3	-15.6	-13.4	-13.4	-17.6	-17.2	-16.5	-18.5	-20.3	-15.8	-9.1	-10.4	-13.3	-15.6

3. Resonant Half-Wave Dipole Models

Reliable 1-g SAR values are available for resonant half-wave dipoles at selected frequencies between 0.3 and 3 GHz in IEEE Standard 1528-2003.⁷ Additional SAR values are also available in the IEEE 1528b draft and IEC 62209-2 between 30 MHz and 6 GHz.⁸ These SAR values have been verified extensively⁹ using finite difference time domain (FDTD) simulations and laboratory measurements at distances of 15 mm at frequencies up to and including 1 GHz and at 10 mm for higher frequencies to provide benchmarks for verifying SAR measurement system accuracy. For the present study, SAR values were computed using the method of moments (MoM) Numerical Electromagnetics Code (NEC-4.1),¹⁰ recruiting the ground plane to simulate standard head tissue with the frequency-dependent dielectric properties shown in Table D-1 above. NEC-4.1 with the Sommerfeld/Norton ground condition was used to compute 1-g SAR values in a cubic centimeter volume just below the ground plane at frequencies up to 3 GHz and these were compared to those specified in IEEE 1528-2003; the results showed good agreement within 3%. The SAR values computed at 5.2 and 5.8 GHz were about 20% lower than that in IEC 62209-2. This difference is suspected to be related to the 1-g SAR averaging method and spatial resolution necessary to capture the steeper field gradients due to the much smaller penetration depth at higher frequencies.¹¹ The result of these NEC-4.1 calculations are shown in Table D-5, where separation distance in this context is defined as the distance from the center of the dipole to the surface of the ground plane, as used in IEEE Standard 1528-2003 for direct comparison. Although this definition of separation distance is in conflict

⁷ IEEE Standards Coordinating Committee 34 (SCC34), Subcommittee 2. *Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques*. IEEE Standard 1528-2003.

⁸ See International Electrotechnical Commission, *Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)*, March 30, 2010.

⁹ *Id.*

¹⁰ NEC-4.1, Lawrence Livermore National Laboratory (LLNL), P.O. Box 808, L-156, Livermore, CA 94550.

¹¹ E-fields are calculated at 1 mm resolution using NEC-4.1 and averaged in an Excel spreadsheet over a 1 cm³ volume centered over the dipole feed-point to determine the 1-g SAR. While this simple grid-by-grid averaging method is convenient, it may not be as accurate as computing the SAR by averaging the 8 corner points surrounding each 1 mm grid volume for extremely steep field gradients at higher frequencies. As higher spatial resolutions are used or denser grid points closer to the tissue surface are selectively chosen in the NEC-4.1 computations, the 1-g SAR gradually exceeds those in IEC 62209-2. The IEC working group also experienced certain difficulties above 3 GHz.

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with our general usage of separation distance,¹² this usage provides a more conservative result, especially at close distances.

4. Plane Wave/Dipole Model to Determine Threshold Power

Given the $1/\sqrt{f_{\text{(GHz)}}}$ frequency dependence in the plane wave model for power density versus SAR, we assume the same frequency dependence for power into a resonant dipole versus SAR and determine a new coefficient (60) for dipoles at approximately 2 cm separation distance. This formula at approximately 2 cm is then exponentially fitted to the values at exactly 20 cm using $ERP_{20\text{cm}}$ derived in section 1 of this appendix. This avoids discontinuities in the threshold when transitioning between SAR- and MPE-based exemption criteria for portable and mobile exposure conditions, providing flexibility for both portable (< 20 cm) devices and mobile (≥ 20 cm) devices up to 40 cm. Finally, the resulting model is validated against NEC-calculated values of SAR at a range of frequencies from 0.3 to 5.8 GHz and separation distances from 0.5 to 20 cm.

The function $60/f_{\text{(GHz)}}$ has in the past been used as a low power threshold by Telecommunications Certification Bodies (TCBs) in the processing of equipment authorization applications. We observe that $60/\sqrt{f_{\text{(GHz)}}}$ (mW) provides conservative power thresholds from 0.3 to 6 GHz at a separation distance of approximately 2 cm. Using this 2 cm formula and according to our NEC calculations, the 1-g SAR varies over a range from 0.29 to 0.57 W/kg, which is 7.4 to 4.5 dB less, respectively, than the limit of 1.6 W/kg over 1 gram.

Field strength, and hence SAR, are expected to attenuate as exponential functions of distance, *i.e.* d^{-x} . The SAR-based criteria considered with a coefficient of 60 and a separation distance of 2 cm can be approximated according d^{-x} , where x is determined from $60/\sqrt{f_{\text{(GHz)}}}$ (mW) at 2 cm and the values of $ERP_{20\text{cm}}$ from section 1 of this appendix for continuity between portable and mobile devices at 20 cm. For this reason, we propose to allow the use of the values calculated without reflection at exactly 20 cm to be flat out to a separation distance of 40 cm where the values of the MPE-based exemption criteria in Appendix C (with reflection) equal these flat values from 20 cm (without reflection) developed here. The values are extrapolated according to the following equations at selected frequencies and for distances between 0.5 and 20 cm as shown in Table D-3 in milliwatts.

$$P_{\text{th}} \text{ (mW)} = ERP_{20\text{cm}} (d / 20 \text{ cm})^x$$

$$\text{where: } x = -\log_{10} \left(\frac{60}{ERP_{20\text{cm}} \sqrt{f}} \right) \text{ and } ERP_{20\text{cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

For the powers in Table D-3, 1-g SAR values estimated using NEC-4.1, half-wave dipoles and the head tissue dielectric parameters specified in OET Bulletin 65 Supplement C (Edition 01-01) and IEEE Std 1528-2003 are shown in Table D-4. The maximum 1-g SAR at various frequencies and distances in Table D-4 are significantly less than 1.6 W/kg over 1-g. The much smaller (< 0.1 W/kg) 1-g SAR values at larger distances (approaching 20 cm) are mainly due to the proposed frequency-dependent mobile exemption power constraint at 20 cm ($ERP_{20\text{cm}}$). This constraint is derived from the MPE limits and OET Bulletin 65 equation (5). The MPE limits assume whole body exposure, which is feasible for humans at

¹² See para. 131 *supra*.

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20 cm, while the SAR-based exemption criteria derived here at less than 20 cm assume only partial body exposure because a planar model is used throughout this appendix.

P_{th} (mW) should be compared with either the available maximum time-averaged power or the maximum time-averaged ERP for a device, whichever is greater, for two reasons. First, it is necessary to use device ERP because for any device with an antenna of significant gain, exemption should be based on the incident power density. Second, it is necessary to use transmitter power because near-field energy coupling effects between a device and the body of a user should be considered due to induced SAR from magnetic fields generated by current flowing along a transmitting antenna or other radiating device structures, especially at distances less than $\lambda/2\pi$. However, if the ERP of a portable device is not easily obtained, then available power may be used (*i.e.*, without consideration of ERP) in comparison with the table only if the device antenna(s) or radiating structure(s) do not exceed the electrical length of $\lambda/4$.¹³

5. Concluding Remarks

Our existing power exclusion thresholds for mobile devices in section 2.1091(c), which assume that persons are normally not closer than 20 cm from any part of the radiating structure, are 1.5 W ERP for transmitters operating at frequencies at or below 1.5 GHz and 3 W ERP for transmitters operating at frequencies above 1.5 GHz. The proposed exemption criteria are similar to these existing power exclusion thresholds above 1.5 GHz between 20 and 40 cm, but consider the potential for whole body resonance at frequencies below 1.5 GHz. These proposed exemption criteria are less restrictive than the existing power exclusion thresholds between 0.8 and 1.5 GHz and additionally allow for extension of these exclusion thresholds down to 0.3 GHz.¹⁴ We propose to allow the use of these exemption criteria out to a separation distance of 40 cm for mobile and fixed RF sources operating between 300 MHz and 6 GHz. At 40 cm, the MPE-based exemption criteria and these SAR-based exemption criteria would be equal.

We recognize that the formulation of exemption criteria is an area of current research¹⁵ and that our independent proposals do not consider the useful variable of bandwidth and resulting electric length limitation. However, such considerations are not consistent with our premise of a model based only on power, distance, and frequency. In addition, such research is only published out to 5 cm and does not consider continuity with far-field exemption criteria. We encourage further research in this area and use of these somewhat more complex exemptions in a sequential approach to determination of compliance, with the goal of eliminating unnecessary SAR measurements where it can be stated with confidence that our limits will not be exceeded.

Generally this sequence for single portable RF sources includes the following steps: (1) determination of 1 mW blanket exemption under section 1.1307(b)(1); (2) determination of exemption under the proposed MPE-based section 1.1307(b)(1)(i) if (1) is not met; (3) determination of exemption under the proposed SAR-based section 1.1307(b)(1)(ii) if both (1) and (2) are not met; (4) streamlined test reduction

¹³ See Harrington, R. F., *Effect of Antenna Size on Gain, Bandwidth, and Efficiency*, Journal of Research of the National Bureau of Standards, Radio Propagation Vol. 64D, No. 1, January-February 1960, pp. 1-12.

¹⁴ See para. 137 *supra*.

¹⁵ See references in this appendix *supra*.

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procedures for evaluation by the FCC Laboratory which may reference current research based on bandwidth, etc. if (1), (2), and (3) are not met; (5) evaluation by SAR measurement or computation if (1), (2), (3), and (4) are not met; then (6) Environmental Assessment (EA) if none of the previous are met (*i.e.*, our exposure limits would be exceeded).¹⁶ This process has been illustrated in the flow chart included herein as Figure D-1.

¹⁶ See Appendix B *supra*.

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Table D-3 – Threshold Powers (mW) at Selected Frequencies (GHz) and Distances from 0.5 to 20 cm

Frequency (GHz)	Distance (cm)															
	0.5	1	1.5	2	2.5	3	4	5	6	7	8	9	10	12.5	15	17.5
0.3	39	65	88	110	130	150	180	220	250	280	310	340	360	430	490	550
0.45	22	44	67	89	110	130	180	230	270	320	360	410	460	570	690	800
0.835	9.2	25	44	66	90	120	170	240	310	390	470	550	640	900	1100	1400
0.9	8.3	23	42	63	88	110	170	240	320	400	480	570	670	900	1200	1500
1.45	4.3	15	30	50	74	100	170	250	350	460	580	720	870	1300	1800	2300
1.8	3.5	13	26	45	67	94	160	240	340	450	570	710	860	1300	1800	2400
1.9	3.4	12	26	44	66	92	160	240	330	440	560	700	850	1300	1800	2400
2.45	2.7	10	22	38	59	83	140	220	310	420	540	670	820	1300	1800	2400
3	2.3	9.0	20	35	53	76	130	210	290	400	510	650	790	1200	1700	2400
5.2	1.5	6.3	15	26	42	61	110	170	250	350	460	590	730	1200	1700	2300
5.8	1.4	5.9	14	25	40	58	110	170	250	340	450	580	720	1100	1700	2300

Table D-4 – Estimated 1-g SAR (W/kg) for $\lambda/2$ Dipole Corresponding to the Threshold Powers in Table D-3

Frequency (GHz)	Distance (cm)															
	0.5	1	1.5	2	2.5	3	4	5	6	7	8	9	10	12.5	15	17.5
0.3	0.17	0.23	0.27	0.29	0.29	0.30	0.28	0.26	0.23	0.20	0.17	0.14	0.12	0.08	0.05	0.04
0.45	0.16	0.26	0.33	0.37	0.39	0.38	0.38	0.34	0.28	0.23	0.18	0.16	0.13	0.08	0.06	0.04
0.835	0.14	0.30	0.41	0.47	0.48	0.48	0.37	0.30	0.24	0.20	0.16	0.14	0.12	0.11	0.10	0.11
0.9	0.15	0.32	0.45	0.51	0.52	0.47	0.38	0.31	0.25	0.20	0.17	0.15	0.13	0.12	0.12	0.13
1.45	0.17	0.43	0.56	0.57	0.51	0.44	0.34	0.27	0.24	0.22	0.22	0.24	0.26	0.29	0.24	0.20
1.8	0.21	0.50	0.56	0.53	0.46	0.39	0.30	0.26	0.25	0.27	0.30	0.33	0.34	0.27	0.24	0.28
1.9	0.21	0.48	0.56	0.51	0.44	0.37	0.29	0.26	0.25	0.28	0.31	0.34	0.33	0.26	0.25	0.28
2.45	0.27	0.53	0.53	0.45	0.37	0.32	0.27	0.30	0.35	0.39	0.37	0.32	0.29	0.34	0.32	0.29
3	0.33	0.56	0.50	0.40	0.33	0.31	0.31	0.40	0.43	0.39	0.33	0.33	0.36	0.35	0.35	0.35
5.2	0.39	0.39	0.33	0.30	0.36	0.44	0.43	0.37	0.44	0.44	0.40	0.46	0.44	0.47	0.47	0.46
5.8	0.34	0.32	0.29	0.31	0.39	0.46	0.40	0.41	0.46	0.40	0.46	0.45	0.44	0.42	0.46	0.46

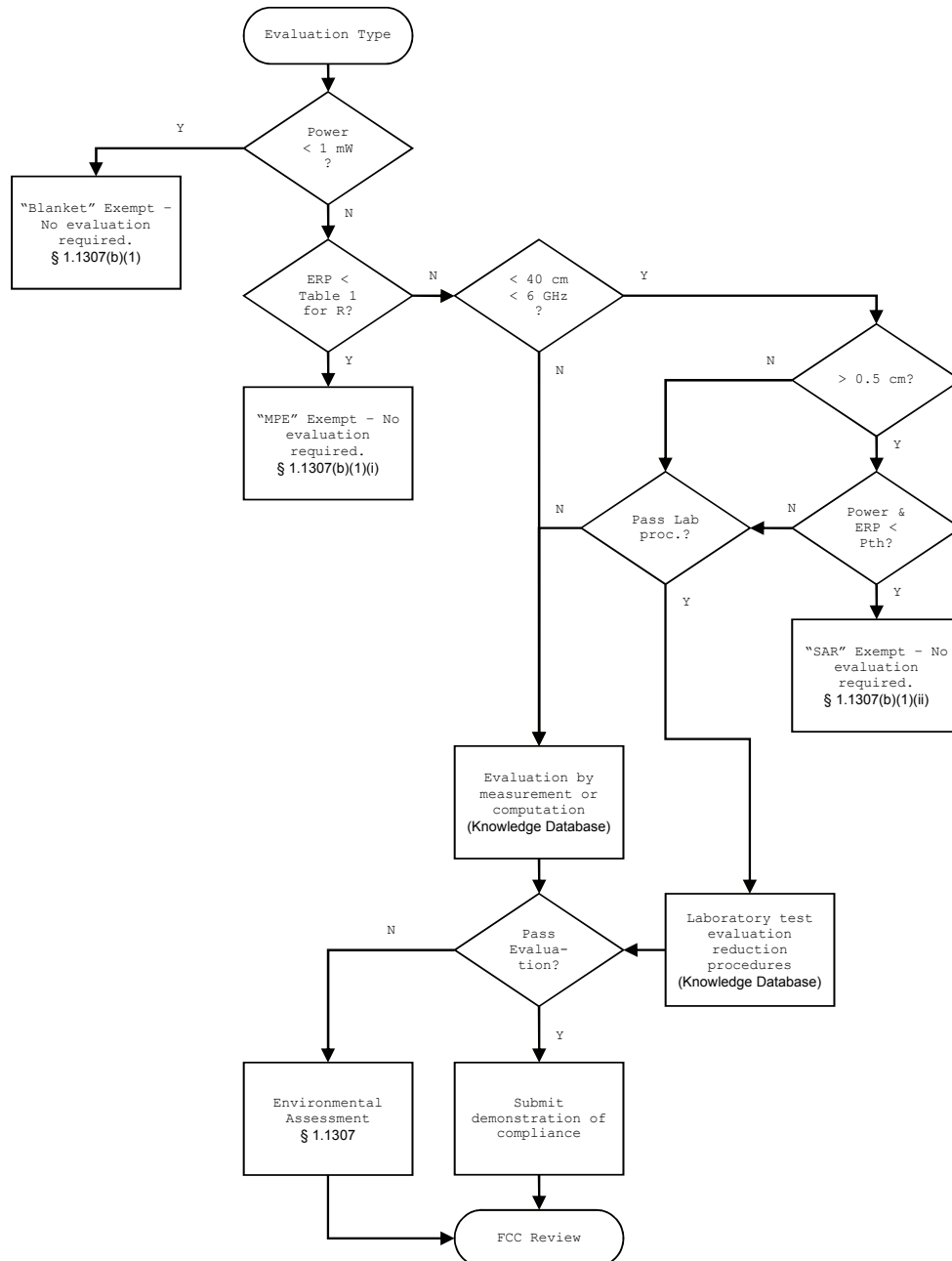
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Table D-5 – 1-g SAR of $\lambda/2$ Dipole at 1.0 W Input (Computed with NEC-4 using dipole specs from IEEE 1528 & IEC

	Distance (cm)															
	0.5	1.0	1.5	2.0	2.5	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	12.5	15.0	17.5
0.3	4.42	3.57	3.03	2.60	2.25	1.97	1.53	1.19	0.92	0.71	0.55	0.43	0.33	0.19	0.11	0.07
0.45	7.45	5.97	4.94	4.14	3.50	2.96	2.10	1.47	1.03	0.72	0.51	0.38	0.28	0.15	0.09	0.06
0.835	15.2	12.0	9.35	7.15	5.38	3.99	2.20	1.25	0.78	0.50	0.34	0.25	0.19	0.12	0.09	0.08
0.9	18.0	14.0	10.73	8.02	5.88	4.26	2.25	1.29	0.77	0.50	0.35	0.25	0.20	0.13	0.10	0.09
1.45	40.7	29.0	18.67	11.42	6.95	4.36	2.00	1.08	0.68	0.49	0.39	0.33	0.30	0.22	0.13	0.09
1.8	58.7	38.2	21.60	11.81	6.85	4.16	1.87	1.08	0.75	0.60	0.52	0.46	0.39	0.21	0.13	0.12
1.9	62.7	39.7	21.71	11.53	6.64	3.99	1.82	1.07	0.76	0.63	0.55	0.48	0.38	0.20	0.14	0.12
2.45	100.6	53.0	23.98	11.74	6.32	3.85	1.95	1.35	1.12	0.93	0.69	0.48	0.36	0.26	0.18	0.12
3.0	143.8	61.8	24.75	11.42	6.28	4.05	2.41	1.91	1.49	0.98	0.65	0.51	0.46	0.29	0.20	0.15
5.2	262.6	62.3	21.69	11.68	8.52	7.17	3.95	2.15	1.75	1.24	0.88	0.77	0.60	0.39	0.27	0.20
5.8	240.8	54.4	20.38	12.23	9.73	7.92	3.62	2.42	1.85	1.19	1.02	0.77	0.61	0.38	0.27	0.20

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Figure D-1 – General Sequence for Determination of Procedure to Establish Compliance with Exposure Limits for a Single RF Source

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APPENDIX E

Final Regulatory Flexibility Analysis

As required by the Regulatory Flexibility Act (RFA),¹ an Initial Regulatory Flexibility Analysis was incorporated in the *Notice of Proposed Rulemaking* (NPRM) in ET Docket 03-137.² The Commission sought written public comment on the proposals in the NPRM, including comment on the IRFA.³ This Final Regulatory Flexibility Analysis (FRFA) conforms to the RFA.

A. Need for, and Objectives of, the Report and Order.

The National Environmental Policy Act of 1969 (NEPA) requires agencies of the Federal Government to evaluate the effects of their actions on the quality of the human environment.⁴ To meet its responsibilities under NEPA, the Commission has adopted requirements for evaluating the environmental impact of its actions. One of several environmental factors addressed by these requirements is human exposure to radiofrequency (RF) energy emitted by FCC-regulated transmitters, facilities and devices.⁵

The Report and Order amends Parts 1, 2 and 95 of our rules relating to the compliance of FCC-regulated transmitters, facilities, and devices with the guidelines for human exposure to radiofrequency (RF) energy adopted by the Commission in 1996 and 1997. Specifically we are making certain revisions in the rules that we believe will result in more efficient, practical and consistent application of compliance procedures.

B. Summary of Significant Issues Raised by Public Comments in Response to the IRFA.

No public comments were filed in response to the IRFA in this proceeding. In addition, no comments were submitted concerning small business issues.

C. Response to Comments by the Chief Counsel for Advocacy of the Small Business Administration.

Pursuant to the Small Business Jobs Act of 2010, the Commission is required to respond to any comments filed by the Chief Counsel for Advocacy of the Small Business Administration, and to provide a detailed statement of any change made to the proposed rules as a result of those comments. The Chief Counsel did not file any comments in response to the proposed rules in this proceeding.

D. Description and Estimate of the Number of Small Entities To Which Rules Will Apply.

The RFA directs agencies to provide a description of, and where feasible, an estimate of the number of small entities that may be affected by the proposed rules and policies, if adopted.⁶ The RFA generally

¹ See 5 U.S.C. § 603. The RFA, see 5 U.S.C. § 601-612 has been amended by the Contract With America Advancement Act of 1996, Public Law 104-121, 110 Stat. 847 (1996) (CWAAA). Title II of the CWAAA is the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA).

² *Notice of Proposed Rulemaking* in ET Docket 03-137 (Proposed Changes in the Commission's Rules Regarding Human Exposure to Radio frequency Electromagnetic Fields), 18 FCC Rcd 13187 (2003).

³ See 5 U.S.C. § 604.

⁴ National Environmental Policy Act of 1969, as amended, 42 U.S.C. 4321-4335.

⁵ See 47 CFR 1.1307(b).

⁶ 5 U.S.C. § 603(b)(3).

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defines the term “small entity” as having the same meaning as the terms “small business,” “small organization,” and “small governmental jurisdiction.”⁷ In addition, the term “small business” has the same meaning as the term “small business concern” under the Small Business Act.⁸ A “small business concern” is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the SBA.⁹

Small Businesses. Nationwide, there are a total of approximately 29.6 million small businesses, according to the SBA.¹⁰

Small Businesses, Small Organizations, and Small Governmental Jurisdictions. Our action may, over time, affect small entities that are not easily categorized at present. We therefore describe here, at the outset, three comprehensive, statutory small entity size standards.¹¹ First, nationwide, there are a total of approximately 27.5 million small businesses, according to the SBA.¹² In addition, a “small organization” is generally “any not-for-profit enterprise which is independently owned and operated and is not dominant in its field.”¹³ Nationwide, as of 2007, there were approximately 1,621,315 small organizations.¹⁴ Finally, the term “small governmental jurisdiction” is defined generally as “governments of cities, towns, townships, villages, school districts, or special districts, with a population of less than fifty thousand.”¹⁵ Census Bureau data for 2011 indicate that there were 89,476 local governmental jurisdictions in the United States.¹⁶ We estimate that, of this total, as many as 88,506 entities may qualify as “small governmental jurisdictions.”¹⁷ Thus, we estimate that most governmental jurisdictions are small.

⁷ 5 U.S.C. § 601(6).

⁸ 5 U.S.C. § 601(3) (incorporating by reference the definition of “small-business concern” in the Small Business Act, 15 U.S.C. § 632). Pursuant to 5 U.S.C. § 601(3), the statutory definition of a small business applies “unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register.”

⁹ 15 U.S.C. § 632.

¹⁰ See SBA, Office of Advocacy, “Frequently Asked Questions,” <http://web.sba.gov/faqs> (accessed Jan. 2009).

¹¹ See 5 U.S.C. §§ 601(3)–(6).

¹² See SBA, Office of Advocacy, “Frequently Asked Questions,” web.sba.gov/faqs (last visited May 6, 2011; figures are from 2009).

¹³ 5 U.S.C. § 601(4).

¹⁴ INDEPENDENT SECTOR, THE NEW NONPROFIT ALMANAC & DESK REFERENCE (2010).

¹⁵ 5 U.S.C. § 601(5).

¹⁶ U.S. CENSUS BUREAU, STATISTICAL ABSTRACT OF THE UNITED STATES: 2011, Table 427 (2007)

¹⁷ The 2007 U.S. Census data for small governmental organizations indicate that there were 89,476 “Local Governments” in 2007. (U.S. CENSUS BUREAU, STATISTICAL ABSTRACT OF THE UNITED STATES 2011, Table 428.) The criterion by which the size of such local governments is determined to be small is a population of 50,000. However, since the Census Bureau does not specifically apply that criterion, it cannot be determined with precision how many of such local governmental organizations is small. Nonetheless, the inference seems reasonable that substantial number of these governmental organizations has a population of less than 50,000. To look at Table 428 in conjunction with a related set of data in Table 429 in the Census’s Statistical Abstract of the U.S., that inference is further supported by the fact that in both Tables, many entities that may well be small are included in the 89,476 local governmental organizations, e.g. county, municipal, township and town, school district and special district entities. Measured by a criterion of a population of 50,000 many specific sub-entities in this category seem more likely than larger county-level governmental organizations to have small populations. Accordingly, of the (continued....)

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Experimental Radio Service (Other Than Broadcast). The majority of experimental licenses are issued to companies such as Motorola and Department of Defense contractors such as Northrop, Lockheed and Martin Marietta. Businesses such as these may have as many as 200 licenses at one time. The majority of these applications are from entities such as these. Given this fact, the remaining 30 percent of applications, we assume, for purposes of our evaluations and conclusions in this FRFA, will be awarded to small entities, as that term is defined by the SBA.

The Commission processes approximately 1,000 applications a year for experimental radio operations. About half or 500 of these are renewals and the other half are for new licenses. We do not have adequate information to predict precisely how many of these applications will be impacted by our rule revisions. However, based on the above figures we estimate that as many as 300 of these applications could be from small entities and potentially could be impacted.

International Broadcast Stations. Commission records show that there are 19 international high frequency broadcast station authorizations. We do not request nor collect annual revenue information, and are unable to estimate the number of international high frequency broadcast stations that would constitute a small business under the SBA definition. Since all international broadcast stations operate using relatively high power levels, it is likely that they could all be impacted by our rule revisions.

Satellite Telecommunications Providers. Two economic census categories address the satellite industry. The first category has a small business size standard of \$15 million or less in average annual receipts, under SBA rules.¹⁸ The second has a size standard of \$25 million or less in annual receipts.¹⁹ The category of Satellite Telecommunications “comprises establishments primarily engaged in providing telecommunications services to other establishments in the telecommunications and broadcasting industries by forwarding and receiving communications signals via a system of satellites or reselling satellite telecommunications.”²⁰ Census Bureau data for 2007 show that 512 Satellite Telecommunications firms that operated for that entire year.²¹ Of this total, 464 firms had annual receipts of under \$10 million, and 18 firms had receipts of \$10 million to \$24,999,999.²² Consequently, the Commission estimates that the majority of Satellite Telecommunications firms are small entities that might be affected by our actions.

The second category, i.e. “All Other Telecommunications” comprises “establishments primarily engaged in providing specialized telecommunications services, such as satellite tracking, communications telemetry, and radar station operation. This industry also includes establishments primarily engaged in providing satellite terminal stations and associated facilities connected with one or more terrestrial systems and capable of transmitting telecommunications to, and receiving telecommunications from, satellite systems. Establishments providing Internet services or voice over Internet protocol (VoIP) services via client-supplied telecommunications connections are also included in this industry.”²³ For this (Continued from previous page) _____

89,746 small governmental organizations identified in the 2007 Census, the Commission estimates that a substantial majority is small. 17 13 C.F.R. § 121.201, NAICS code 517110.

¹⁸ 13 C.F.R. § 121.201, NAICS code 517410.

¹⁹ 13 C.F.R. § 121.201, NAICS code 517919.

²⁰ U.S. Census Bureau, 2007 NAICS Definitions, 517410 Satellite Telecommunications.

²¹ See http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-_skip=900&-ds_name=EC0751SSSZ4&-_lang=en.

²² See http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-_skip=900&-ds_name=EC0751SSSZ4&-_lang=en.

²³ <http://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517919&search=2007%20NAICS%20Search>.

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category, Census Bureau data for 2007 shows that there were a total of 2,383 firms that operated for the entire year.²⁴ Of this total, 2,347 firms had annual receipts of under \$25 million and 12 firms had annual receipts of \$25 million to \$49, 999,999.²⁵ Consequently, the Commission estimates that the majority of All Other Telecommunications firms are small entities that might be affected by our actions.

Fixed Satellite Transmit/Receive Earth Stations. There are approximately 4,303 earth station authorizations, a portion of which are Fixed Satellite Transmit/Receive Earth Stations. We do not request nor collect annual revenue information, and are unable to estimate the number of the earth stations that would constitute a small business under the SBA definition. However, the majority of these stations could be impacted by our revised rules.

Fixed Satellite Small Transmit/Receive Earth Stations. There are approximately 4,303 earth station authorizations, a portion of which are Fixed Satellite Small Transmit/Receive Earth Stations. We do not request nor collect annual revenue information, and are unable to estimate the number of fixed small satellite transmit/receive earth stations that would constitute a small business under the SBA definition. However, the majority of these stations could be impacted by our revised rules.

Fixed Satellite Very Small Aperture Terminal (VSAT) Systems. These stations operate on a primary basis, and frequency coordination with terrestrial microwave systems is not required. Thus, a single "blanket" application may be filed for a specified number of small antennas and one or more hub stations. There are 492 current VSAT System authorizations. We do not request nor collect annual revenue information, and are unable to estimate the number of VSAT systems that would constitute a small business under the SBA definition. However, it is expected that many of these stations could be impacted by our revised rules.

Mobile Satellite Earth Stations. There are 19 licensees. We do not request nor collect annual revenue information, and are unable to estimate the number of mobile satellite earth stations that would constitute a small business under the SBA definition. However, it is expected that many of these stations could be impacted by our revised rules.

Wireless Telecommunications Carriers (except satellite). This industry comprises establishments engaged in operating and maintaining switching and transmission facilities to provide communications via the airwaves. Establishments in this industry have spectrum licenses and provide services using that spectrum, such as cellular phone services, paging services, wireless Internet access, and wireless video services.²⁶ The appropriate size standard under SBA rules is for the category Wireless Telecommunications Carriers. The size standard for that category is that a business is small if it has 1,500 or fewer employees.²⁷ Under the present and prior categories, the SBA has deemed a wireless business to be small if it has 1,500 or fewer employees.²⁸ For this category, census data for 2007 show that there

²⁴ http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-_skip=900&-ds_name=EC0751SSSZ4&_lang=en.

²⁵ http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-_skip=900&-ds_name=EC0751SSSZ4&_lang=en.

²⁶ <http://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517210&search=2007%20NAICS%20Search>

²⁷ 13 C.F.R. § 121.201, NAICS code 517210.

²⁸ 13 C.F.R. § 121.201, NAICS code 517210. The now-superseded, pre-2007 C.F.R. citations were 13 C.F.R. § 121.201, NAICS codes 517211 and 517212 (referring to the 2002 NAICS).

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were 1,383 firms that operated for the entire year.²⁹ Of this total, 1,368 firms had employment of 999 or fewer employees and 15 had employment of 1000 employees or more.³⁰ Thus under this category and the associated small business size standard, the Commission estimates that the majority of wireless telecommunications carriers(except satellite) are small entities that may be affected by our proposed actions.³¹

Licenses Assigned by Auctions. Initially, we note that, as a general matter, the number of winning bidders that qualify as small businesses at the close of an auction does not necessarily represent the number of small businesses currently in service. Also, the Commission does not generally track subsequent business size unless, in the context of assignments or transfers, unjust enrichment issues are implicated.

Paging Services. Neither the SBA nor the FCC has developed a definition applicable exclusively to paging services. However, a variety of paging services is now categorized under Wireless Telecommunications Carriers (except satellite).³² This industry comprises establishments engaged in operating and maintaining switching and transmission facilities to provide communications via the airwaves. Establishments in this industry have spectrum licenses and provide services using that spectrum, such as cellular phone services, paging services, wireless Internet access, and wireless video services. Illustrative examples in the paging context include paging services, except satellite; two-way paging communications carriers, except satellite; and radio paging services communications carriers. The SBA has deemed a paging service in this category to be small if it has 1,500 or fewer employees.³³ For this category, census data for 2007 show that there were 1,383 firms that operated for the entire year.³⁴ Of this total, 1,368 firms had employment of 999 or fewer employees and 15 had employment of 1000 employees or more.³⁵ Thus under this category and the associated small business size standard, the Commission estimates that the majority of paging services in the category of wireless telecommunications carriers(except satellite) are small entities that may be affected by our actions.³⁶

In addition, in the Paging Second Report and Order, the Commission adopted a size standard for “small businesses” for purposes of determining their eligibility for special provisions such as bidding credits.³⁷

²⁹ U.S. Census Bureau, Subject Series: Information, Table 5, “Establishment and Firm Size: Employment Size of Firms for the United States: 2007 NAICS Code 517210” (issued Nov. 2010).

³⁰ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “100 employees or more.”

³¹ See http://factfinder.census.gov/servlet/IBQTable?_bm=y&-fds_name=EC0700A1&-geo_id=&-skip=600&-ds_name=EC0751SSSZ5&-lang=en

³² U.S. Census Bureau, 2007 NAICS Definitions, “517210 Wireless Telecommunications Categories (Except Satellite)”; <http://www.census.gov/naics/2007/def/ND517210.HTM#N517210>

³³ U.S. Census Bureau, 2007 NAICS Definitions, “517210 Wireless Telecommunications Categories (Except Satellite)”

³⁴ U.S. Census Bureau, Subject Series: Information, Table 5, “Establishment and Firm Size: Employment Size of Firms for the United States: 2007 NAICS Code 517210” (issued Nov. 2010).

³⁵ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “100 employees or more.”

³⁶ See http://factfinder.census.gov/servlet/IBQTable?_bm=y&-fds_name=EC0700A1&-geo_id=&-skip=600&-ds_name=EC0751SSSZ5&-lang=en

³⁷ *Revision of Part 22 and Part 90 of the Commission’s Rules to Facilitate Future Development of Paging Systems*, Second Report and Order, 12 FCC Rcd 2732, 2811-2812, paras. 178-181 (“*Paging Second Report and Order*”); see also *Revision of Part 22 and Part 90 of the Commission’s Rules to Facilitate Future Development of Paging* (continued....)

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A small business is an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$15 million for the preceding three years.³⁸ The SBA has approved this definition.³⁹ An initial auction of Metropolitan Economic Area (“MEA”) licenses was conducted in the year 2000. Of the 2,499 licenses auctioned, 985 were sold.⁴⁰ Fifty-seven companies claiming small business status won 440 licenses.⁴¹ A subsequent auction of MEA and Economic Area (“EA”) licenses was held in the year 2001. Of the 15,514 licenses auctioned, 5,323 were sold.⁴² One hundred thirty-two companies claiming small business status purchased 3,724 licenses. A third auction, consisting of 8,874 licenses in each of 175 EAs and 1,328 licenses in all but three of the 51 MEAs, was held in 2003. Seventy-seven bidders claiming small or very small business status won 2,093 licenses.⁴³ A fourth auction of 9,603 lower and upper band paging licenses was held in the year 2010. 29 bidders claiming small or very small business status won 3,016 licenses.

2.3 GHz Wireless Communications Services. This service can be used for fixed, mobile, radiolocation, and digital audio broadcasting satellite uses. The Commission defined “small business” for the wireless communications services (“WCS”) auction as an entity with average gross revenues of \$40 million for each of the three preceding years, and a “very small business” as an entity with average gross revenues of \$15 million for each of the three preceding years.⁴⁴ The SBA approved these definitions.⁴⁵ The Commission conducted an auction of geographic area licenses in the WCS service in 1997. In the auction, seven bidders that qualified as very small business entities won 31 licenses, and one bidder that qualified as a small business entity won a license.

1670-1675 MHz Services. This service can be used for fixed and mobile uses, except aeronautical mobile.⁴⁶ An auction for one license in the 1670-1675 MHz band was conducted in 2003. The Commission defined a “small business” as an entity with attributable average annual gross revenues of not more than \$40 million for the preceding three years, which would thus be eligible for a 15 percent discount on its winning bid for the 1670-1675 MHz band license. Further, the Commission defined a “very small business” as an entity with attributable average annual gross revenues of not more than \$15 million for the preceding three years, which would thus be eligible to receive a 25 percent discount on its winning bid for the 1670-1675 MHz band license. The winning bidder was not a small entity.

(Continued from previous page) _____

Systems, Memorandum Opinion and Order on Reconsideration, 14 FCC Rcd 10030, 10085-10088, ¶¶ 98-107 (1999).

³⁸ *Paging Second Report and Order*, 12 FCC Rcd at 2811, ¶ 179.

³⁹ See Letter from Aida Alvarez, Administrator, SBA, to Amy Zoslov, Chief, Auctions and Industry Analysis Division, Wireless Telecommunications Bureau (“WTB”), FCC (Dec. 2, 1998) (“*Alvarez Letter 1998*”).

⁴⁰ See “929 and 931 MHz Paging Auction Closes,” Public Notice, 15 FCC Rcd 4858 (WTB 2000).

⁴¹ See *id.*

⁴² See “Lower and Upper Paging Band Auction Closes,” Public Notice, 16 FCC Rcd 21821 (WTB 2002).

⁴³ See “Lower and Upper Paging Bands Auction Closes,” Public Notice, 18 FCC Rcd 11154 (WTB 2003). The current number of small or very small business entities that hold wireless licenses may differ significantly from the number of such entities that won in spectrum auctions due to assignments and transfers of licenses in the secondary market over time. In addition, some of the same small business entities may have won licenses in more than one auction.

⁴⁴ *Amendment of the Commission’s Rules to Establish Part 27, the Wireless Communications Service (WCS)*, Report and Order, 12 FCC Rcd 10785, 10879, para. 194 (1997).

⁴⁵ See *Alvarez Letter 1998*.

⁴⁶ 47 C.F.R. § 2.106; see generally 47 C.F.R. §§ 27.1–.70.

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Wireless Telephony. Wireless telephony includes cellular, personal communications services, and specialized mobile radio telephony carriers. As noted, the SBA has developed a small business size standard for Wireless Telecommunications Carriers (except Satellite).⁴⁷ Under the SBA small business size standard, a business is small if it has 1,500 or fewer employees.⁴⁸ Census data for 2007 shows that there were 1,383 firms that operated that year.⁴⁹ Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus under this category and the associated small business size standard, the majority of firms can be considered small. According to Trends in Telephone Service data, 434 carriers reported that they were engaged in wireless telephony.⁵⁰ Of these, an estimated 222 have 1,500 or fewer employees and 212 have more than 1,500 employees.⁵¹ Therefore, approximately half of these entities can be considered small. Similarly, according to Commission data, 413 carriers reported that they were engaged in the provision of wireless telephony, including cellular service, Personal Communications Service (PCS), and Specialized Mobile Radio (SMR) Telephony services.⁵² Of these, an estimated 261 have 1,500 or fewer employees and 152 have more than 1,500 employees.⁵³ Consequently, the Commission estimates that approximately half or more of these firms can be considered small. Thus, using available data, we estimate that the majority of wireless firms can be considered small.

Broadband Personal Communications Service. *Broadband Personal Communications Service.* The broadband personal communications services (PCS) spectrum is divided into six frequency blocks designated A through F, and the Commission has held auctions for each block. The Commission initially defined a “small business” for C- and F-Block licenses as an entity that has average gross revenues of \$40 million or less in the three previous years.⁵⁴ For F-Block licenses, an additional small business size standard for “very small business” was added and is defined as an entity that, together with its affiliates, has average gross revenues of not more than \$15 million for the preceding three years.⁵⁵ These small business size standards, in the context of broadband PCS auctions, have been approved by the SBA.⁵⁶ No small businesses within the SBA-approved small business size standards bid successfully for licenses in Blocks A and B. There were 90 winning bidders that claimed small business status in the first two C-Block auctions. A total of 93 bidders that claimed small and very small business status won approximately 40 percent of the 1,479 licenses in the first auction for the D, E, and F Blocks.⁵⁷ On April 15, 1999, the Commission completed the re-auction of 347 C-, D-, E-, and F-Block licenses in Auction

⁴⁷ 13 C.F.R. § 121.201, NAICS code 517210.

⁴⁸ *Id.*

⁴⁹ U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-_skip=700&-ds_name=EC0751SSSZ5&-_lang=en.

⁵⁰ *Trends in Telephone Service*, at tbl. 5.3.

⁵¹ *Id.*

⁵² *See Trends in Telephone Service*, at tbl. 5.3.

⁵³ *See id.*

⁵⁴ *See Amendment of Parts 20 and 24 of the Commission's Rules – Broadband PCS Competitive Bidding and the Commercial Mobile Radio Service Spectrum Cap; Amendment of the Commission's Cellular/PCS Cross-Ownership Rule*, WT Docket No. 96-59, GN Docket No. 90-314, Report and Order, 11 FCC Rcd 7824, 7850–52 ¶¶ 57–60 (1996) (“PCS Report and Order”); *see also* 47 C.F.R. § 24.720(b).

⁵⁵ *See PCS Report and Order*, 11 FCC Rcd at 7852 ¶ 60.

⁵⁶ *See Alvarez Letter 1998*.

⁵⁷ *See Broadband PCS, D, E and F Block Auction Closes*, Public Notice, Doc. No. 89838 (rel. Jan. 14, 1997).

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No. 22.⁵⁸ Of the 57 winning bidders in that auction, 48 claimed small business status and won 277 licenses.

On January 26, 2001, the Commission completed the auction of 422 C and F Block Broadband PCS licenses in Auction No. 35. Of the 35 winning bidders in that auction, 29 claimed small business status.⁵⁹ Subsequent events concerning Auction 35, including judicial and agency determinations, resulted in a total of 163 C and F Block licenses being available for grant. On February 15, 2005, the Commission completed an auction of 242 C-, D-, E-, and F-Block licenses in Auction No. 58. Of the 24 winning bidders in that auction, 16 claimed small business status and won 156 licenses.⁶⁰ On May 21, 2007, the Commission completed an auction of 33 licenses in the A, C, and F Blocks in Auction No. 71.⁶¹ Of the 14 winning bidders in that auction, six claimed small business status and won 18 licenses.⁶² On August 20, 2008, the Commission completed the auction of 20 C-, D-, E-, and F-Block Broadband PCS licenses in Auction No. 78.⁶³ Of the eight winning bidders for Broadband PCS licenses in that auction, six claimed small business status and won 14 licenses.⁶⁴

Advanced Wireless Services. In 2006, the Commission conducted its first auction of Advanced Wireless Services licenses in the 1710-1755 MHz and 2110-2155 MHz bands (“AWS-1”), designated as Auction 66.⁶⁵ For the AWS-1 bands, the Commission has defined a “small business” as an entity with average annual gross revenues for the preceding three years not exceeding \$40 million, and a “very small business” as an entity with average annual gross revenues for the preceding three years not exceeding \$15 million.⁶⁶ In 2006, the Commission conducted its first auction of AWS-1 licenses.⁶⁷ In that initial AWS-

⁵⁸ See *C, D, E, and F Block Broadband PCS Auction Closes*, Public Notice, 14 FCC Rcd 6688 (WTB 1999). Before Auction No. 22, the Commission established a very small standard for the C Block to match the standard used for F Block. *Amendment of the Commission’s Rules Regarding Installment Payment Financing for Personal Communications Services (PCS) Licensees*, WT Docket No. 97-82, Fourth Report and Order, 13 FCC Rcd 15743, 15768 ¶ 46 (1998).

⁵⁹ See *C and F Block Broadband PCS Auction Closes; Winning Bidders Announced*, Public Notice, 16 FCC Rcd 2339 (2001).

⁶⁰ See *Broadband PCS Spectrum Auction Closes; Winning Bidders Announced for Auction No. 58*, Public Notice, 20 FCC Rcd 3703 (2005).

⁶¹ See *Auction of Broadband PCS Spectrum Licenses Closes; Winning Bidders Announced for Auction No. 71*, Public Notice, 22 FCC Rcd 9247 (2007).

⁶² *Id.*

⁶³ See *Auction of AWS-1 and Broadband PCS Licenses Closes; Winning Bidders Announced for Auction 78*, Public Notice, 23 FCC Rcd 12749 (WTB 2008).

⁶⁴ *Id.*

⁶⁵ See *Auction of Advanced Wireless Services Licenses Scheduled for June 29, 2006; Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments and Other Procedures for Auction No. 66*, AU Docket No. 06-30, *Public Notice*, 21 FCC Rcd 4562 (2006) (“*Auction 66 Procedures Public Notice*”);

⁶⁶ See *Service Rules for Advanced Wireless Services in the 1.7 GHz and 2.1 GHz Bands, Report and Order*, 18 FCC Rcd 25,162, App. B (2003), *modified by* *Service Rules for Advanced Wireless Services In the 1.7 GHz and 2.1 GHz Bands, Order on Reconsideration*, 20 FCC Rcd 14,058, App. C (2005).

⁶⁷ See *Auction of Advanced Wireless Services Licenses Scheduled for June 29, 2006; Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments and Other Procedures for Auction No. 66*, AU Docket No. 06-30, *Public Notice*, 21 FCC Rcd 4562 (2006) (“*Auction 66 Procedures Public Notice*”).

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1 auction, 31 winning bidders identified themselves as very small businesses won 142 licenses.⁶⁸ Twenty-six of the winning bidders identified themselves as small businesses and won 73 licenses.⁶⁹ In a subsequent 2008 auction, the Commission offered 35 AWS-1 licenses.⁷⁰ Four winning bidders identified themselves as very small businesses, and three of the winning bidders identifying themselves as a small businesses won five AWS-1 licenses.⁷¹

Narrowband Personal Communications Services. In 1994, the Commission conducted two auctions of Narrowband PCS licenses. For these auctions, the Commission defined a “small business” as an entity with average annual gross revenues for the preceding three years not exceeding \$40 million.⁷² Through these auctions, the Commission awarded a total of 41 licenses, 11 of which were obtained by four small businesses.⁷³ To ensure meaningful participation by small business entities in future auctions, the Commission adopted a two-tiered small business size standard in the *Narrowband PCS Second Report and Order*.⁷⁴ A “small business” is an entity that, together with affiliates and controlling interests, has average gross revenues for the three preceding years of not more than \$40 million.⁷⁵ A “very small business” is an entity that, together with affiliates and controlling interests, has average gross revenues for the three preceding years of not more than \$15 million.⁷⁶ The SBA has approved these small business size standards.⁷⁷ A third auction of Narrowband PCS licenses was conducted in 2001. In that auction, five bidders won 317 (Metropolitan Trading Areas and nationwide) licenses.⁷⁸ Three of the winning bidders claimed status as a small or very small entity and won 311 licenses.

Lower 700 MHz Band Licenses. The Commission previously adopted criteria for defining three groups of small businesses for purposes of determining their eligibility for special provisions such as bidding credits.⁷⁹ The Commission defined a “small business” as an entity that, together with its affiliates and

⁶⁸ See *Auction of Advanced Wireless Services Licenses Closes; Winning Bidders Announced for Auction No. 66*, Public Notice, 21 FCC Rcd 10,521 (2006) (“*Auction 66 Closing Public Notice*”).

⁶⁹ See *id.*

⁷⁰ See *AWS-1 and Broadband PCS Procedures Public Notice*, 23 FCC Rcd at 7499. Auction 78 also included an auction of broadband PCS licenses.

⁷¹ See *Auction of AWS-1 and Broadband PCS Licenses Closes, Winning Bidders Announced for Auction 78, Down Payments Due September 9, 2008, FCC Forms 601 and 602 Due September 9, 2008, Final Payments Due September 23, 2008, Ten-Day Petition to Deny Period*, Public Notice, 23 FCC Rcd 12,749 (2008).

⁷² *Implementation of Section 309(j) of the Communications Act – Competitive Bidding Narrowband PCS*, Third Memorandum Opinion and Order and Further Notice of Proposed Rulemaking, 10 FCC Rcd 175, 196, para. 46 (1994).

⁷³ See “Announcing the High Bidders in the Auction of Ten Nationwide Narrowband PCS Licenses, Winning Bids Total \$617,006,674,” *Public Notice*, PNWL 94-004 (rel. Aug. 2, 1994); “Announcing the High Bidders in the Auction of 30 Regional Narrowband PCS Licenses; Winning Bids Total \$490,901,787,” *Public Notice*, PNWL 94-27 (rel. Nov. 9, 1994).

⁷⁴ *Amendment of the Commission’s Rules to Establish New Personal Communications Services, Narrowband PCS, Second Report and Order and Second Further Notice of Proposed Rule Making*, 15 FCC Rcd 10456, 10476, para. 40 (2000) (“*Narrowband PCS Second Report and Order*”).

⁷⁵ *Narrowband PCS Second Report and Order*, 15 FCC Rcd at 10476, para. 40.

⁷⁶ *Id.*

⁷⁷ See *Alvarez Letter 1998*.

⁷⁸ See “Narrowband PCS Auction Closes,” *Public Notice*, 16 FCC Rcd 18663 (WTB 2001).

⁷⁹ See *Reallocation and Service Rules for the 698-746 MHz Spectrum Band (Television Channels 52-59)*, Report and Order, 17 FCC Rcd 1022 (2002) (“*Channels 52-59 Report and Order*”).

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controlling principals, has average gross revenues not exceeding \$40 million for the preceding three years.⁸⁰ A “very small business” is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues that are not more than \$15 million for the preceding three years.⁸¹ Additionally, the Lower 700 MHz Service had a third category of small business status for Metropolitan/Rural Service Area (“MSA/RSA”) licenses —“entrepreneur”— which is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues that are not more than \$3 million for the preceding three years.⁸² The SBA approved these small size standards.⁸³ An auction of 740 licenses was conducted in 2002 (one license in each of the 734 MSAs/RSAs and one license in each of the six Economic Area Groupings (EAGs)). Of the 740 licenses available for auction, 484 licenses were won by 102 winning bidders. Seventy-two of the winning bidders claimed small business, very small business, or entrepreneur status and won a total of 329 licenses.⁸⁴ A second auction commenced on May 28, 2003, closed on June 13, 2003, and included 256 licenses.⁸⁵ Seventeen winning bidders claimed small or very small business status and won 60 licenses, and nine winning bidders claimed entrepreneur status and won 154 licenses.⁸⁶ In 2005, the Commission completed an auction of 5 licenses in the lower 700 MHz band (Auction 60). All three winning bidders claimed small business status.

In 2007, the Commission reexamined its rules governing the 700 MHz band in the *700 MHz Second Report and Order*.⁸⁷ An auction of A, B and E block licenses in the Lower 700 MHz band was held in 2008.⁸⁸ Twenty winning bidders claimed small business status (those with attributable average annual gross revenues that exceed \$15 million and do not exceed \$40 million for the preceding three years). Thirty three winning bidders claimed very small business status (those with attributable average annual gross revenues that do not exceed \$15 million for the preceding three years). In 2011, the Commission conducted Auction 92, which offered 16 lower 700 MHz band licenses that had been made available in Auction 73 but either remained unsold or were licenses on which a winning bidder defaulted. Two of the seven winning bidders in Auction 92 claimed very small business status, winning a total of four licenses.

⁸⁰ See *Channels 52-59 Report and Order*, 17 FCC Rcd at 1087-88, ¶ 172.

⁸¹ See *id.*

⁸² See *id.*, 17 FCC Rcd at 1088, ¶ 173.

⁸³ See Letter from Aida Alvarez, Administrator, SBA, to Thomas Sugrue, Chief, WTB, FCC (Aug. 10, 1999) (“*Alvarez Letter 1999*”).

⁸⁴ See “Lower 700 MHz Band Auction Closes,” *Public Notice*, 17 FCC Rcd 17272 (WTB 2002).

⁸⁵ See Lower 700 MHz Band Auction Closes, *Public Notice*, 18 FCC Rcd 11873 (WTB 2003).

⁸⁶ See *id.*

⁸⁷ Service Rules for the 698-746, 747-762 and 777-792 MHz Band, WT Docket No. 06-150, *Revision of the Commission’s Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems*, CC Docket No. 94-102, Section 68.4(a) of the Commission’s Rules Governing Hearing Aid-Compatible Telephone, WT Docket No. 01-309, *Biennial Regulatory Review – Amendment of Parts 1, 22, 24, 27, and 90 to Streamline and Harmonize Various Rules Affecting Wireless Radio Services*, WT Docket No. 03-264, *Former Nextel Communications, Inc. Upper 700 MHz Guard Band Licenses and Revisions to Part 27 of the Commission’s Rules*, WT Docket No. 06-169, *Implementing a Nationwide, Broadband Interoperable Public Safety Network in the 700 MHz Band*, PS Docket No. 06-229, *Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State, and Local Public Safety Communications Requirements Through the Year 2010*, WT Docket No. 96-86, *Second Report and Order*, 22 FCC Rcd 15289 (2007) (“*700 MHz Second Report and Order*”).

⁸⁸ See Auction of 700 MHz Band Licenses Closes, *Public Notice*, 23 FCC Rcd 4572 (WTB 2008).

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Upper 700 MHz Band Licenses. In the *700 MHz Second Report and Order*, the Commission revised its rules regarding Upper 700 MHz licenses.⁸⁹ On January 24, 2008, the Commission commenced Auction 73 in which several licenses in the Upper 700 MHz band were available for licensing: 12 Regional Economic Area Grouping licenses in the C Block, and one nationwide license in the D Block.⁹⁰ The auction concluded on March 18, 2008, with 3 winning bidders claiming very small business status (those with attributable average annual gross revenues that do not exceed \$15 million for the preceding three years) and winning five licenses.

700 MHz Guard Band Licenses. In 2000, the Commission adopted the *700 MHz Guard Band Report and Order*, in which it established rules for the A and B block licenses in the Upper 700 MHz band, including size standards for “small businesses” and “very small businesses” for purposes of determining their eligibility for special provisions such as bidding credits.⁹¹ A small business in this service is an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$40 million for the preceding three years.⁹² Additionally, a very small business is an entity that, together with its affiliates and controlling principals, has average gross revenues that are not more than \$15 million for the preceding three years.⁹³ SBA approval of these definitions is not required.⁹⁴ An auction of these licenses was conducted in 2000.⁹⁵ Of the 104 licenses auctioned, 96 licenses were won by nine bidders. Five of these bidders were small businesses that won a total of 26 licenses. A second auction of 700 MHz Guard Band licenses was held in 2001. All eight of the licenses auctioned were sold to three bidders. One of these bidders was a small business that won a total of two licenses.⁹⁶

Specialized Mobile Radio. The Commission adopted small business size standards for the purpose of determining eligibility for bidding credits in auctions of Specialized Mobile Radio (SMR) geographic area licenses in the 800 MHz and 900 MHz bands. The Commission defined a “small business” as an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$15 million for the preceding three years.⁹⁷ The Commission defined a “very small business” as an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$3 million for the preceding three years.⁹⁸ The SBA has approved these small business size standards for both the 800 MHz and 900 MHz SMR Service.⁹⁹ The first 900 MHz SMR auction was completed in 1996. Sixty bidders claiming that they qualified as small businesses under the \$15 million size standard

⁸⁹ *700 MHz Second Report and Order*, 22 FCC Rcd 15289.

⁹⁰ *See Auction of 700 MHz Band Licenses Closes*, Public Notice, 23 FCC Rcd 4572 (WTB 2008).

⁹¹ *See Service Rules for the 746-764 MHz Bands, and Revisions to Part 27 of the Commission's Rules*, Second Report and Order, 15 FCC Rcd 5299 (2000) (“*700 MHz Guard Band Report and Order*”).

⁹² *See 700 MHz Guard Band Report and Order*, 15 FCC Rcd at 5343, para. 108.

⁹³ *See id.*

⁹⁴ *See id.*, 15 FCC Rcd 5299, 5343, para. 108 n.246 (for the 746-764 MHz and 776-794 MHz bands, the Commission is exempt from 15 U.S.C. § 632, which requires Federal agencies to obtain SBA approval before adopting small business size standards).

⁹⁵ *See “700 MHz Guard Bands Auction Closes: Winning Bidders Announced,” Public Notice*, 15 FCC Rcd 18026 (2000).

⁹⁶ *See “700 MHz Guard Bands Auction Closes: Winning Bidders Announced,” Public Notice*, 16 FCC Rcd 4590 (WTB 2001).

⁹⁷ 47 C.F.R. §§ 90.810, 90.814(b), 90.912.

⁹⁸ 47 C.F.R. §§ 90.810, 90.814(b), 90.912.

⁹⁹ *See Alvarez Letter 1999*.

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won 263 licenses in the 900 MHz SMR band. In 2004, the Commission held a second auction of 900 MHz SMR licenses and three winning bidders identifying themselves as very small businesses won 7 licenses.¹⁰⁰ The auction of 800 MHz SMR licenses for the upper 200 channels was conducted in 1997. Ten bidders claiming that they qualified as small or very small businesses under the \$15 million size standard won 38 licenses for the upper 200 channels.¹⁰¹ A second auction of 800 MHz SMR licenses was conducted in 2002 and included 23 BEA licenses. One bidder claiming small business status won five licenses.¹⁰²

The auction of the 1,053 800 MHz SMR licenses for the General Category channels was conducted in 2000. Eleven bidders who won 108 licenses for the General Category channels in the 800 MHz SMR band qualified as small or very small businesses.¹⁰³ In an auction completed in 2000, a total of 2,800 Economic Area licenses in the lower 80 channels of the 800 MHz SMR service were awarded.¹⁰⁴ Of the 22 winning bidders, 19 claimed small or very small business status and won 129 licenses. Thus, combining all four auctions, 41 winning bidders for geographic licenses in the 800 MHz SMR band claimed to be small businesses.

In addition, there are numerous incumbent site-by-site SMR licensees and licensees with extended implementation authorizations in the 800 and 900 MHz bands. We do not know how many firms provide 800 MHz or 900 MHz geographic area SMR pursuant to extended implementation authorizations, nor how many of these providers have annual revenues not exceeding \$15 million. One firm has over \$15 million in revenues. In addition, we do not know how many of these firms have 1500 or fewer employees.¹⁰⁵ We assume, for purposes of this analysis, that all of the remaining existing extended implementation authorizations are held by small entities, as that small business size standard is approved by the SBA.

220 MHz Radio Service – Phase I Licensees. The 220 MHz service has both Phase I and Phase II licenses. Phase I licensing was conducted by lotteries in 1992 and 1993. There are approximately 1,515 such non-nationwide licensees and four nationwide licensees currently authorized to operate in the 220 MHz band. The Commission has not developed a small business size standard for small entities specifically applicable to such incumbent 220 MHz Phase I licensees. To estimate the number of such licensees that are small businesses, the Commission applies the small business size standard under the SBA rules applicable. The SBA has deemed a wireless business to be small if it has 1,500 or fewer employees.¹⁰⁶ For this service, the SBA uses the category of Wireless Telecommunications Carriers (except Satellite). Census data for 2007, which supersede data contained in the 2002 Census, show that

¹⁰⁰ See 900 MHz Specialized Mobile Radio Service Spectrum Auction Closes: Winning Bidders Announced,” *Public Notice*, 19 FCC Rcd. 3921 (WTB 2004).

¹⁰¹ See “Correction to Public Notice DA 96-586 ‘FCC Announces Winning Bidders in the Auction of 1020 Licenses to Provide 900 MHz SMR in Major Trading Areas,’” *Public Notice*, 18 FCC Rcd 18367 (WTB 1996).

¹⁰² See “Multi-Radio Service Auction Closes,” *Public Notice*, 17 FCC Rcd 1446 (WTB 2002).

¹⁰³ See “800 MHz Specialized Mobile Radio (SMR) Service General Category (851-854 MHz) and Upper Band (861-865 MHz) Auction Closes; Winning Bidders Announced,” *Public Notice*, 15 FCC Rcd 17162 (2000).

¹⁰⁴ See, “800 MHz SMR Service Lower 80 Channels Auction Closes; Winning Bidders Announced,” *Public Notice*, 16 FCC Rcd 1736 (2000).

¹⁰⁵ See generally 13 C.F.R. § 121.201, NAICS code 517210.

¹⁰⁶ 13 C.F.R. § 121.201, NAICS code 517210 (2007 NAICS). The now-superseded, pre-2007 C.F.R. citations were 13 C.F.R. § 121.201, NAICS codes 517211 and 517212 (referring to the 2002 NAICS).

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there were 1,383 firms that operated that year.¹⁰⁷ Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus under this category and the associated small business size standard, the majority of firms can be considered small.

220 MHz Radio Service – Phase II Licensees. The 220 MHz service has both Phase I and Phase II licenses. The Phase II 220 MHz service licenses are assigned by auction, where mutually exclusive applications are accepted. In the *220 MHz Third Report and Order*, the Commission adopted a small business size standard for defining “small” and “very small” businesses for purposes of determining their eligibility for special provisions such as bidding credits.¹⁰⁸ This small business standard indicates that a “small business” is an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$15 million for the preceding three years.¹⁰⁹ A “very small business” is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues that do not exceed \$3 million for the preceding three years.¹¹⁰ The SBA has approved these small size standards.¹¹¹ Auctions of Phase II licenses commenced on and closed in 1998.¹¹² In the first auction, 908 licenses were auctioned in three different-sized geographic areas: three nationwide licenses, 30 Regional Economic Area Group (EAG) Licenses, and 875 Economic Area (EA) Licenses. Of the 908 licenses auctioned, 693 were sold.¹¹³ Thirty-nine small businesses won 373 licenses in the first 220 MHz auction. A second auction included 225 licenses: 216 EA licenses and 9 EAG licenses. Fourteen companies claiming small business status won 158 licenses.¹¹⁴ A third auction included four licenses: 2 BEA licenses and 2 EAG licenses in the 220 MHz Service. No small or very small business won any of these licenses.¹¹⁵ In 2007, the Commission conducted a fourth auction of the 220 MHz licenses, designated as Auction 72.¹¹⁶ Auction 72, which offered 94 Phase II 220 MHz Service licenses, concluded in 2007.¹¹⁷ In this auction, five winning bidders won a total of 76 licenses. Two winning bidders identified themselves as very small businesses won 56 of the 76 licenses. One of the winning bidders that identified themselves as a small business won 5 of the 76 licenses won.

¹⁰⁷ U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-skip=700&-ds_name=EC0751SSSZ5&-_lang=en.

¹⁰⁸ *Amendment of Part 90 of the Commission’s Rules to Provide For the Use of the 220-222 MHz Band by the Private Land Mobile Radio Service*, Third Report and Order, 12 FCC Rcd 10943, 11068-70 ¶¶ 291-295 (1997).

¹⁰⁹ *Id.* at 11068 ¶ 291.

¹¹⁰ *Id.*

¹¹¹ See Letter to Daniel Phythyon, Chief, Wireless Telecommunications Bureau, Federal Communications Commission, from Aida Alvarez, Administrator, Small Business Administration, dated January 6, 1998 (*Alvarez to Phythyon Letter 1998*).

¹¹² See generally *220 MHz Service Auction Closes*, Public Notice, 14 FCC Rcd 605 (WTB 1998).

¹¹³ See *FCC Announces It is Prepared to Grant 654 Phase II 220 MHz Licenses After Final Payment is Made*, Public Notice, 14 FCC Rcd 1085 (WTB 1999).

¹¹⁴ See *Phase II 220 MHz Service Spectrum Auction Closes*, Public Notice, 14 FCC Rcd 11218 (WTB 1999).

¹¹⁵ See *Multi-Radio Service Auction Closes*, Public Notice, 17 FCC Rcd 1446 (WTB 2002).

¹¹⁶ See “Auction of Phase II 220 MHz Service Spectrum Scheduled for June 20, 2007, Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments and Other Procedures for Auction 72, *Public Notice*, 22 FCC Rcd 3404 (2007).

¹¹⁷ See *Auction of Phase II 220 MHz Service Spectrum Licenses Closes, Winning Bidders Announced for Auction 72, Down Payments due July 18, 2007, FCC Forms 601 and 602 due July 18, 2007, Final Payments due August 1, 2007, Ten-Day Petition to Deny Period*, Public Notice, 22 FCC Rcd 11573 (2007).

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Private Land Mobile Radio (“PLMR”). PLMR systems serve an essential role in a range of industrial, business, land transportation, and public safety activities. These radios are used by companies of all sizes operating in all U.S. business categories, and are often used in support of the licensee’s primary (non-telecommunications) business operations. For the purpose of determining whether a licensee of a PLMR system is a small business as defined by the SBA, we use the broad census category, Wireless Telecommunications Carriers (except Satellite). This definition provides that a small entity is any such entity employing no more than 1,500 persons.¹¹⁸ The Commission does not require PLMR licensees to disclose information about number of employees, so the Commission does not have information that could be used to determine how many PLMR licensees constitute small entities under this definition. We note that PLMR licensees generally use the licensed facilities in support of other business activities, and therefore, it would also be helpful to assess PLMR licensees under the standards applied to the particular industry subsector to which the licensee belongs.¹¹⁹

As of March 2010, there were 424,162 PLMR licensees operating 921,909 transmitters in the PLMR bands below 512 MHz. We note that any entity engaged in a commercial activity is eligible to hold a PLMR license, and that any revised rules in this context could therefore potentially impact small entities covering a great variety of industries.

Fixed Microwave Services. Microwave services include common carrier,¹²⁰ private-operational fixed,¹²¹ and broadcast auxiliary radio services.¹²² They also include the Local Multipoint Distribution Service (“LMDS”),¹²³ the Digital Electronic Message Service (“DEMS”),¹²⁴ and the 24 GHz Service,¹²⁵ where licensees can choose between common carrier and non-common carrier status.¹²⁶ The Commission has not yet defined a small business with respect to microwave services. For purposes of this IRFA, the Commission will use the SBA’s definition applicable to Wireless Telecommunications Carriers (except satellite)—i.e., an entity with no more than 1,500 persons is considered small.¹²⁷ For the category of Wireless Telecommunications Carriers (except Satellite), Census data for 2007 shows that there were 1,383 firms that operated that year.¹²⁸ Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus under this category and the associated small business size standard,

¹¹⁸ See 13 C.F.R. § 121.201, NAICS code 517210.

¹¹⁹ See generally 13 C.F.R. § 121.201.

¹²⁰ See 47 C.F.R. Part 101, Subparts C and I.

¹²¹ See *id.* Subparts C and H.

¹²² Auxiliary Microwave Service is governed by Part 74 of Title 47 of the Commission’s Rules. See 47 C.F.R. Part 74. Available to licensees of broadcast stations and to broadcast and cable network entities, broadcast auxiliary microwave stations are used for relaying broadcast television signals from the studio to the transmitter, or between two points such as a main studio and an auxiliary studio. The service also includes mobile TV pickups, which relay signals from a remote location back to the studio.

¹²³ See 47 C.F.R. Part 101, Subpart L.

¹²⁴ See *id.* Subpart G.

¹²⁵ See *id.*

¹²⁶ See 47 C.F.R. §§ 101.533, 101.1017.

¹²⁷ 13 C.F.R. § 121.201, NAICS code 517210.

¹²⁸ U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-_skip=700&-ds_name=EC0751SSSZ5&-_lang=en.
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the majority of firms can be considered small. The Commission notes that the number of firms does not necessarily track the number of licensees. The Commission estimates that virtually all of the Fixed Microwave licensees (excluding broadcast auxiliary licensees) would qualify as small entities under the SBA definition.

39 GHz Service. The Commission adopted small business size standards for 39 GHz licenses. A “small business” is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$40 million in the preceding three years.¹²⁹ A “very small business” is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues of not more than \$15 million for the preceding three years.¹³⁰ The SBA has approved these small business size standards.¹³¹ In 2000, the Commission conducted an auction of 2,173 39 GHz licenses. A total of 18 bidders who claimed small or very small business status won 849 licenses.

Local Multipoint Distribution Service. Local Multipoint Distribution Service (“LMDS”) is a fixed broadband point-to-multipoint microwave service that provides for two-way video telecommunications.¹³² The Commission established a small business size standard for LMDS licenses as an entity that has average gross revenues of less than \$40 million in the three previous years.¹³³ An additional small business size standard for “very small business” was added as an entity that, together with its affiliates, has average gross revenues of not more than \$15 million for the preceding three years.¹³⁴ The SBA has approved these small business size standards in the context of LMDS auctions.¹³⁵ There were 93 winning bidders that qualified as small entities in the LMDS auctions. A total of 93 small and very small business bidders won approximately 277 A Block licenses and 387 B Block licenses. In 1999, the Commission re-auctioned 161 licenses; there were 32 small and very small businesses winning that won 119 licenses.

218-219 MHz Service. The first auction of 218-219 MHz Service (previously referred to as the Interactive and Video Data Service or IVDS) licenses resulted in 170 entities winning licenses for 594 Metropolitan Statistical Areas (“MSAs”).¹³⁶ Of the 594 licenses, 557 were won by 167 entities qualifying as a small business. For that auction, the Commission defined a small business as an entity that, together with its affiliates, has no more than a \$6 million net worth and, after federal income taxes (excluding any carry over losses), has no more than \$2 million in annual profits each year for the previous two years.¹³⁷ In the *218-219 MHz Report and Order and Memorandum Opinion and Order*, the Commission revised its

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¹²⁹ See *Amendment of the Commission's Rules Regarding the 37.0-38.6 GHz and 38.6-40.0 GHz Bands*, ET Docket No. 95-183, Report and Order, 12 FCC Rcd 18600 (1997).

¹³⁰ *Id.*

¹³¹ See Letter from Aida Alvarez, Administrator, SBA, to Kathleen O'Brien Ham, Chief, Auctions and Industry Analysis Division, WTB, FCC (Feb. 4, 1998); see Letter from Hector Barreto, Administrator, SBA, to Margaret Wiener, Chief, Auctions and Industry Analysis Division, WTB, FCC (Jan. 18, 2002).

¹³² See [*Rulemaking to Amend Parts 1, 2, 21, 25, of the Commission's Rules to Redesignate the 27.5-29.5 GHz Frequency Band, Reallocate the 29.5-30.5 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services*](#), CC Docket No. 92-297, Second Report and Order, Order on Reconsideration, and Fifth Notice of Proposed Rule Making, 12 FCC Rcd 12545, 12689-90, para. 348 (1997) (“*LMDS Second Report and Order*”).

¹³³ See [*LMDS Second Report and Order*](#), 12 FCC Rcd at 12689-90, para. 348.

¹³⁴ See *id.*

¹³⁵ See Alvarez to Phythyon Letter 1998.

¹³⁶ See “*Interactive Video and Data Service (IVDS) Applications Accepted for Filing*,” Public Notice, 9 FCC Rcd 6227 (1994).

¹³⁷ *Implementation of Section 309(j) of the Communications Act – Competitive Bidding*, Fourth Report and Order, 9 FCC Rcd 2330 (1994).

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small business size standards for the 218-219 MHz Service and defined a small business as an entity that, together with its affiliates and persons or entities that hold interests in such an entity and their affiliates, has average annual gross revenues not exceeding \$15 million for the preceding three years.¹³⁸ The Commission defined a “very small business” as an entity that, together with its affiliates and persons or entities that hold interests in such an entity and its affiliates, has average annual gross revenues not exceeding \$3 million for the preceding three years.¹³⁹ The SBA has approved these definitions.¹⁴⁰

Location and Monitoring Service (“LMS”). Multilateration LMS systems use non-voice radio techniques to determine the location and status of mobile radio units. For auctions of LMS licenses, the Commission has defined a “small business” as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the preceding three years not exceeding \$15 million.¹⁴¹ A “very small business” is defined as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the preceding three years not exceeding \$3 million.¹⁴² These definitions have been approved by the SBA.¹⁴³ An auction of LMS licenses was conducted in 1999. Of the 528 licenses auctioned, 289 licenses were sold to four small businesses.

Rural Radiotelephone Service. The Commission has not adopted a size standard for small businesses specific to the Rural Radiotelephone Service.¹⁴⁴ A significant subset of the Rural Radiotelephone Service is the Basic Exchange Telephone Radio System (“BETRS”).¹⁴⁵ For purposes of its analysis of the Rural Radiotelephone Service, the Commission uses the SBA small business size standard for the category “Wireless Telecommunications Carriers (except satellite),” which is 1,500 or fewer employees.¹⁴⁶ Census data for 2007 shows that there were 1,383 firms that operated that year.¹⁴⁷ Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus under this category and the associated small business size standard, the majority of firms in the Rural Radiotelephone Service can be considered small.

Air-Ground Radiotelephone Service.¹⁴⁸ The Commission has previously used the SBA’s small business definition applicable to Wireless Telecommunications Carriers (except Satellite), *i.e.*, an entity employing no more than 1,500 persons.¹⁴⁹ There are approximately 100 licensees in the Air-Ground

¹³⁸ *Amendment of Part 95 of the Commission’s Rules to Provide Regulatory Flexibility in the 218-219 MHz Service*, Report and Order and Memorandum Opinion and Order, 15 FCC Rcd 1497 (1999).

¹³⁹ *Id.*

¹⁴⁰ *See Alvarez to Phythyon Letter 1998.*

¹⁴¹ *Amendment of Part 90 of the Commission’s Rules to Adopt Regulations for Automatic Vehicle Monitoring Systems*, Second Report and Order, 13 FCC Rcd 15182, 15192, ¶ 20 (1998) (“*Automatic Vehicle Monitoring Systems Second Report and Order*”); *see also* 47 C.F.R. § 90.1103.

¹⁴² *Automatic Vehicle Monitoring Systems Second Report and Order*, 13 FCC Rcd at 15192, para. 20; *see also* 47 C.F.R. § 90.1103.

¹⁴³ *See Alvarez Letter 1998.*

¹⁴⁴ The service is defined in section 22.99 of the Commission’s Rules, 47 C.F.R. § 22.99.

¹⁴⁵ BETRS is defined in sections 22.757 and 22.759 of the Commission’s Rules, 47 C.F.R. §§ 22.757 and 22.759.

¹⁴⁶ 13 C.F.R. § 121.201, NAICS code 517210.

¹⁴⁷ U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-_skip=700&-ds_name=EC0751SSSZ5&-_lang=en.

¹⁴⁸ The service is defined in § 22.99 of the Commission’s Rules, 47 C.F.R. § 22.99.

¹⁴⁹ 13 C.F.R. § 121.201, NAICS codes 517210.

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Radiotelephone Service, and under that definition, we estimate that almost all of them qualify as small entities under the SBA definition. For purposes of assigning Air-Ground Radiotelephone Service licenses through competitive bidding, the Commission has defined “small business” as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the preceding three years not exceeding \$40 million.¹⁵⁰ A “very small business” is defined as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the preceding three years not exceeding \$15 million.¹⁵¹ These definitions were approved by the SBA.¹⁵² In 2006, the Commission completed an auction of nationwide commercial Air-Ground Radiotelephone Service licenses in the 800 MHz band (Auction 65). The auction closed with two winning bidders winning two Air-Ground Radiotelephone Services licenses. Neither of the winning bidders claimed small business status.

Aviation and Marine Radio Services. Small businesses in the aviation and marine radio services use a very high frequency (“VHF”) marine or aircraft radio and, as appropriate, an emergency position-indicating radio beacon (and/or radar) or an emergency locator transmitter. The Commission has not developed a small business size standard specifically applicable to these small businesses. For purposes of this analysis, the Commission uses the SBA small business size standard for the category Wireless Telecommunications Carriers (except satellite),” which is 1,500 or fewer employees.¹⁵³ Census data for 2007 shows that there were 1,383 firms that operated that year.¹⁵⁴ Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus under this category and the associated small business size standard, the majority of firms can be considered small.

Offshore Radiotelephone Service. This service operates on several UHF television broadcast channels that are not used for television broadcasting in the coastal areas of states bordering the Gulf of Mexico.¹⁵⁵ There are presently approximately 55 licensees in this service. The Commission is unable to estimate at this time the number of licensees that would qualify as small under the SBA’s small business size standard for the category of Wireless Telecommunications Carriers (except Satellite). Under that standard,¹⁵⁶ Under that SBA small business size standard, a business is small if it has 1,500 or fewer employees.¹⁵⁷ Census data for 2007 shows that there were 1,383 firms that operated that year.¹⁵⁸ Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus under this category and the associated small business size standard, the majority of firms can be considered small.

¹⁵⁰ *Amendment of Part 22 of the Commission’s Rules to Benefit the Consumers of Air-Ground Telecommunications Services, Biennial Regulatory Review – Amendment of Parts 1, 22, and 90 of the Commission’s Rules, Amendment of Parts 1 and 22 of the Commission’s Rules to Adopt Competitive Bidding Rules for Commercial and General Aviation Air-Ground Radiotelephone Service*, WT Docket Nos. 03-103 and 05-42, Order on Reconsideration and Report and Order, 20 FCC Red 19663, ¶¶ 28-42 (2005).

¹⁵¹ *Id.*

¹⁵² See Letter from Hector V. Barreto, Administrator, SBA, to Gary D. Michaels, Deputy Chief, Auctions and Spectrum Access Division, WTB, FCC (Sept. 19, 2005).

¹⁵³ 13 C.F.R. § 121.201, NAICS code 517210.

¹⁵⁴ U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-_skip=700&-ds_name=EC0751SSSZ5&-_lang=en.

¹⁵⁵ This service is governed by Subpart I of Part 22 of the Commission’s Rules. See 47 C.F.R. §§ 22.1001-22.1037.

¹⁵⁶ 13 C.F.R. § 121.201, NAICS code 517210.

¹⁵⁷ *Id.*

¹⁵⁸ U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-_skip=700&-ds_name=EC0751SSSZ5&-_lang=en.

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Multiple Address Systems (“MAS”). Entities using MAS spectrum, in general, fall into two categories: (1) those using the spectrum for profit-based uses, and (2) those using the spectrum for private internal uses. The Commission defines a small business for MAS licenses as an entity that has average gross revenues of less than \$15 million in the preceding three years.¹⁵⁹ A very small business is defined as an entity that, together with its affiliates, has average gross revenues of not more than \$3 million for the preceding three years.¹⁶⁰ The SBA has approved these definitions.¹⁶¹ The majority of these entities will most likely be licensed in bands where the Commission has implemented a geographic area licensing approach that would require the use of competitive bidding procedures to resolve mutually exclusive applications. The Commission’s licensing database indicates that, as of March 5, 2010, there were over 11,500 MAS station authorizations. In 2001, an auction of 5,104 MAS licenses in 176 EAs was conducted.¹⁶² Seven winning bidders claimed status as small or very small businesses and won 611 licenses. In 2005, the Commission completed an auction (Auction 59) of 4,226 MAS licenses in the Fixed Microwave Services from the 928/959 and 932/941 MHz bands. Twenty-six winning bidders won a total of 2,323 licenses. Of the 26 winning bidders in this auction, five claimed small business status and won 1,891 licenses.

With respect to entities that use, or seek to use, MAS spectrum to accommodate internal communications needs, we note that MAS serves an essential role in a range of industrial, safety, business, and land transportation activities. MAS radios are used by companies of all sizes, operating in virtually all U.S. business categories, and by all types of public safety entities. For the majority of private internal users, the small business size standard developed by the SBA would be more appropriate. The applicable size standard in this instance appears to be that of Wireless Telecommunications Carriers (except Satellite). This definition provides that a small entity is any such entity employing no more than 1,500 persons.¹⁶³ The Commission’s licensing database indicates that, as of January 20, 1999, of the 8,670 total MAS station authorizations, 8,410 authorizations were for private radio service, and of these, 1,433 were for private land mobile radio service.

1.4 GHz Band Licensees. The Commission conducted an auction of 64 1.4 GHz band licenses in the paired 1392-1395 MHz and 1432-1435 MHz bands, and in the unpaired 1390-1392 MHz band in 2007.¹⁶⁴ For these licenses, the Commission defined “small business” as an entity that, together with its affiliates and controlling interests, had average gross revenues not exceeding \$40 million for the preceding three years, and a “very small business” as an entity that, together with its affiliates and controlling interests, has had average annual gross revenues not exceeding \$15 million for the preceding three years.¹⁶⁵ Neither of the two winning bidders claimed small business status.¹⁶⁶

¹⁵⁹ See *Amendment of the Commission’s Rules Regarding Multiple Address Systems*, Report and Order, 15 FCC Rcd 11956, 12008, ¶ 123 (2000).

¹⁶⁰ *Id.*

¹⁶¹ See *Alvarez Letter 1999*.

¹⁶² See “*Multiple Address Systems Spectrum Auction Closes*,” Public Notice, 16 FCC Rcd 21011 (2001).

¹⁶³ See 13 C.F.R. § 121.201, NAICS code 517210.

¹⁶⁴ See “*Auction of 1.4 GHz Band Licenses Scheduled for February 7, 2007*,” Public Notice, 21 FCC Rcd 12393 (WTB 2006); “*Auction of 1.4 GHz Band Licenses Closes; Winning Bidders Announced for Auction No. 69*,” Public Notice, 22 FCC Rcd 4714 (2007) (“*Auction No. 69 Closing PN*”).

¹⁶⁵ *Auction No. 69 Closing PN*, Attachment C.

¹⁶⁶ See *Auction No. 69 Closing PN*.

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Incumbent 24 GHz Licensees. This analysis may affect incumbent licensees who were relocated to the 24 GHz band from the 18 GHz band, and applicants who wish to provide services in the 24 GHz band. For this service, the Commission uses the SBA small business size standard for the category “Wireless Telecommunications Carriers (except satellite),” which is 1,500 or fewer employees.¹⁶⁷ To gauge small business prevalence for these cable services we must, however, use the most current census data. Census data for 2007 shows that there were 1,383 firms that operated that year.¹⁶⁸ Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus under this category and the associated small business size standard, the majority of firms can be considered small. The Commission notes that the Census’ use of the classifications “firms” does not track the number of “licenses”. The Commission believes that there are only two licensees in the 24 GHz band that were relocated from the 18 GHz band, Teligent¹⁶⁹ and TRW, Inc. It is our understanding that Teligent and its related companies have less than 1,500 employees, though this may change in the future. TRW is not a small entity. Thus, only one incumbent licensee in the 24 GHz band is a small business entity.

Future 24 GHz Licensees. With respect to new applicants for licenses in the 24 GHz band, for the purpose of determining eligibility for bidding credits, the Commission established three small business definitions. An “entrepreneur” is defined as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the three preceding years not exceeding \$40 million.¹⁷⁰ A “small business” is defined as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the three preceding years not exceeding \$15 million.¹⁷¹ A “very small business” in the 24 GHz band is defined as an entity that, together with controlling interests and affiliates, has average gross revenues not exceeding \$3 million for the preceding three years.¹⁷² The SBA has approved these small business size standards.¹⁷³ In a 2004 auction of 24 GHz licenses, three winning bidders won seven licenses.¹⁷⁴ Two of the winning bidders were very small businesses that won five licenses.

Broadband Radio Service and Educational Broadband Service. Broadband Radio Service systems, previously referred to as Multipoint Distribution Service (“MDS”) and Multichannel Multipoint Distribution Service (“MMDS”) systems, and “wireless cable,” transmit video programming to subscribers and provide two-way high speed data operations using the microwave frequencies of the Broadband Radio Service (“BRS”) and Educational Broadband Service (“EBS”) (previously referred to as

¹⁶⁷ 13 C.F.R. § 121.201, NAICS code 517210.

¹⁶⁸ U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-_skip=700&-ds_name=EC0751SSSZ5&-_lang=en.

¹⁶⁹ Teligent acquired the DEMS licenses of FirstMark, the only licensee other than TRW in the 24 GHz band whose license has been modified to require relocation to the 24 GHz band.

¹⁷⁰ *Amendments to Parts 1, 2, 87 and 101 of the Commission’s Rules To License Fixed Services at 24 GHz*, Report and Order, 15 FCC Rcd 16934, 16967 ¶ 77 (2000) (“*24 GHz Report and Order*”); *see also* 47 C.F.R. § 101.538(a)(3).

¹⁷¹ *24 GHz Report and Order*, 15 FCC Rcd at 16967 ¶ 77; *see also* 47 C.F.R. § 101.538(a)(2).

¹⁷² *24 GHz Report and Order*, 15 FCC Rcd at 16967 ¶ 77; *see also* 47 C.F.R. § 101.538(a)(1).

¹⁷³ *See* Letter to Margaret W. Wiener, Deputy Chief, Auctions and Industry Analysis Division, Wireless Telecommunications Bureau, FCC, from Gary M. Jackson, Assistant Administrator, SBA (July 28, 2000).

¹⁷⁴ *Auction of 24 GHz Service Spectrum Auction Closes, Winning Bidders Announced for Auction 56, Down Payments Due August 16, 2004, Final Payments Due August 30, 2004, Ten-Day Petition to Deny Period*, Public Notice, 19 FCC Rcd 14738 (2004).

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the Instructional Television Fixed Service (“ITFS”).¹⁷⁵ In connection with the 1996 BRS auction, the Commission established a small business size standard as an entity that had annual average gross revenues of no more than \$40 million in the previous three years.¹⁷⁶ The BRS auctions resulted in 67 successful bidders obtaining licensing opportunities for 493 Basic Trading Areas (“BTAs”). Of the 67 auction winners, 61 met the definition of a small business. BRS also includes licensees of stations authorized prior to the auction. At this time, we estimate that of the 61 small business BRS auction winners, 48 remain small business licensees. In addition to the 48 small businesses that hold BTA authorizations, there are approximately 392 incumbent BRS licensees that are considered small entities.¹⁷⁷ After adding the number of small business auction licensees to the number of incumbent licensees not already counted, we find that there are currently approximately 440 BRS licensees that are defined as small businesses under either the SBA or the Commission’s rules. In 2009, the Commission conducted Auction 86, the sale of 78 licenses in the BRS areas.¹⁷⁸ The Commission offered three levels of bidding credits: (i) a bidder with attributed average annual gross revenues that exceed \$15 million and do not exceed \$40 million for the preceding three years (small business) will receive a 15 percent discount on its winning bid; (ii) a bidder with attributed average annual gross revenues that exceed \$3 million and do not exceed \$15 million for the preceding three years (very small business) will receive a 25 percent discount on its winning bid; and (iii) a bidder with attributed average annual gross revenues that do not exceed \$3 million for the preceding three years (entrepreneur) will receive a 35 percent discount on its winning bid.¹⁷⁹ Auction 86 concluded in 2009 with the sale of 61 licenses.¹⁸⁰ Of the ten winning bidders, two bidders that claimed small business status won 4 licenses; one bidder that claimed very small business status won three licenses; and two bidders that claimed entrepreneur status won six licenses.

In addition, the SBA’s Cable Television Distribution Services small business size standard is applicable to EBS. There are presently 2,032 EBS licensees. All but 100 of these licenses are held by educational institutions. Educational institutions are included in this analysis as small entities.¹⁸¹ Thus, we estimate that at least 1,932 licensees are small businesses. Since 2007, Cable Television Distribution Services have been defined within the broad economic census category of Wired Telecommunications Carriers; that category is defined as follows: “This industry comprises establishments primarily engaged in operating and/or providing access to transmission facilities and infrastructure that they own and/or lease for the transmission of voice, data, text, sound, and video using wired telecommunications networks.

¹⁷⁵ *Amendment of Parts 21 and 74 of the Commission’s Rules with Regard to Filing Procedures in the Multipoint Distribution Service and in the Instructional Television Fixed Service and Implementation of Section 309(j) of the Communications Act—Competitive Bidding*, MM Docket No. 94-131, PP Docket No. 93-253, Report and Order, 10 FCC Rcd 9589, 9593 ¶ 7 (1995).

¹⁷⁶ 47 C.F.R. § 21.961(b)(1).

¹⁷⁷ 47 U.S.C. § 309(j). Hundreds of stations were licensed to incumbent MDS licensees prior to implementation of Section 309(j) of the Communications Act of 1934, 47 U.S.C. § 309(j). For these pre-auction licenses, the applicable standard is SBA’s small business size standard of 1500 or fewer employees.

¹⁷⁸ *Auction of Broadband Radio Service (BRS) Licenses, Scheduled for October 27, 2009, Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments, and Other Procedures for Auction 86*, Public Notice, 24 FCC Rcd 8277 (2009).

¹⁷⁹ *Id.* at 8296.

¹⁸⁰ *Auction of Broadband Radio Service Licenses Closes, Winning Bidders Announced for Auction 86, Down Payments Due November 23, 2009, Final Payments Due December 8, 2009, Ten-Day Petition to Deny Period*, Public Notice, 24 FCC Rcd 13572 (2009).

¹⁸¹ The term “small entity” within SBREFA applies to small organizations (nonprofits) and to small governmental jurisdictions (cities, counties, towns, townships, villages, school districts, and special districts with populations of less than 50,000). 5 U.S.C. §§ 601(4)–(6). We do not collect annual revenue data on EBS licensees.

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Transmission facilities may be based on a single technology or a combination of technologies.”¹⁸² For these services, the Commission uses the SBA small business size standard for the category “Wireless Telecommunications Carriers (except satellite),” which is 1,500 or fewer employees.¹⁸³ To gauge small business prevalence for these cable services we must, however, use the most current census data. According to Census Bureau data for 2007, there were a total of 955 firms in this previous category that operated for the entire year.¹⁸⁴ Of this total, 939 firms employed 999 or fewer employees, and 16 firms employed 1,000 employees or more.¹⁸⁵ Thus, the majority of these firms can be considered small.

Television Broadcasting. This Economic Census category “comprises establishments primarily engaged in broadcasting images together with sound. These establishments operate television broadcasting studios and facilities for the programming and transmission of programs to the public.”¹⁸⁶ The SBA has created the following small business size standard for Television Broadcasting firms: those having \$14 million or less in annual receipts.¹⁸⁷ The Commission has estimated the number of licensed commercial television stations to be 1,387.¹⁸⁸ In addition, according to Commission staff review of the BIA Advisory Services, LLC’s *Media Access Pro Television Database* on March 28, 2012, about 950 of an estimated 1,300 commercial television stations (or approximately 73 percent) had revenues of \$14 million or less.¹⁸⁹ We therefore estimate that the majority of commercial television broadcasters are small entities.

We note, however, that in assessing whether a business concern qualifies as small under the above definition, business (control) affiliations¹⁹⁰ must be included. Our estimate, therefore, likely overstates the number of small entities that might be affected by our action because the revenue figure on which it is based does not include or aggregate revenues from affiliated companies. In addition, an element of the definition of “small business” is that the entity not be dominant in its field of operation. We are unable at this time to define or quantify the criteria that would establish whether a specific television station is dominant in its field of operation. Accordingly, the estimate of small businesses to which rules may apply does not exclude any television station from the definition of a small business on this basis and is therefore possibly over-inclusive to that extent.

In addition, the Commission has estimated the number of licensed noncommercial educational (NCE) television stations to be 396.¹⁹¹ These stations are non-profit, and therefore considered to be small entities.¹⁹²

¹⁸² U.S. Census Bureau, 2007 NAICS Definitions, 517110 Wired Telecommunications Carriers, (partial definition), www.census.gov/naics/2007/def/ND517110.HTM#N517110.

¹⁸³ 13 C.F.R. § 121.201, NAICS code 517210.

¹⁸⁴ U.S. Census Bureau, 2007 Economic Census, Subject Series: Information, Table 5, Employment Size of Firms for the United States: 2007, NAICS code 5171102 (issued November 2010).

¹⁸⁵ *Id.*

¹⁸⁶ U.S. Census Bureau, 2007 NAICS Definitions, “515120 Television Broadcasting” (partial definition); <http://www.census.gov/naics/2007/def/ND515120.HTM#N515120>.

¹⁸⁷ 13 C.F.R. § 121.201, NAICS code 515120 (updated for inflation in 2010).

¹⁸⁸ See *FCC News Release*, “Broadcast Station Totals as of December 31, 2011,” dated January 6, 2012; http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-311837A1.pdf.

¹⁸⁹ We recognize that BIA’s estimate differs slightly from the FCC total given *supra*.

¹⁹⁰ “[Business concerns] are affiliates of each other when one concern controls or has the power to control the other or a third party or parties controls or has to power to control both.” 13 C.F.R. § 21.103(a)(1).

¹⁹¹ See *FCC News Release*, “Broadcast Station Totals as of December 31, 2011,” dated January 6, 2012; http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0106/DOC-311837A1.pdf.

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In addition, there are also 2,528 low power television stations, including Class A stations (LPTV).¹⁹³ Given the nature of these services, we will presume that all LPTV licensees qualify as small entities under the above SBA small business size standard.

Radio Broadcasting. This Economic Census category “comprises establishments primarily engaged in broadcasting aural programs by radio to the public. Programming may originate in their own studio, from an affiliated network, or from external sources.”¹⁹⁴ The SBA has established a small business size standard for this category, which is: such firms having \$7 million or less in annual receipts.¹⁹⁵ According to Commission staff review of BIA Advisory Services, LLC’s *Media Access Pro Radio Database* on March 28, 2012, about 10,759 (97%) of 11,102 commercial radio stations had revenues of \$7 million or less. Therefore, the majority of such entities are small entities.

We note, however, that in assessing whether a business concern qualifies as small under the above size standard, business affiliations must be included.¹⁹⁶ In addition, to be determined to be a “small business,” the entity may not be dominant in its field of operation.¹⁹⁷ We note that it is difficult at times to assess these criteria in the context of media entities, and our estimate of small businesses may therefore be over-inclusive.

Auxiliary, Special Broadcast and Other Program Distribution Services. This service involves a variety of transmitters, generally used to relay broadcast programming to the public (through translator and booster stations) or within the program distribution chain (from a remote news gathering unit back to the station). The Commission has not developed a definition of small entities applicable to broadcast auxiliary licensees. The applicable definitions of small entities are those, noted previously, under the SBA rules applicable to radio broadcasting stations and television broadcasting stations.¹⁹⁸

The Commission estimates that there are approximately 6,099 FM translators and boosters.¹⁹⁹ The Commission does not collect financial information on any broadcast facility, and the Department of Commerce does not collect financial information on these auxiliary broadcast facilities. We believe that most, if not all, of these auxiliary facilities could be classified as small businesses by themselves. We also recognize that most commercial translators and boosters are owned by a parent station which, in some cases, would be covered by the revenue definition of small business entity discussed above. These stations would likely have annual revenues that exceed the SBA maximum to be designated as a small business (\$7.0 million for a radio station or \$14.0 million for a TV station). Furthermore, they do not

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¹⁹² See generally 5 U.S.C. §§ 601(4), (6).

¹⁹³ See *FCC News Release*, “Broadcast Station Totals as of December 31, 2011,” dated January 6, 2012; http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0106/DOC-311837A1.pdf.

¹⁹⁴ U.S. Census Bureau, 2007 NAICS Definitions, “515112 Radio Stations”; <http://www.census.gov/naics/2007/def/ND515112.HTM#N515112>.

¹⁹⁵ 13 C.F.R. § 121.201, NAICS code 515112 (updated for inflation in 2010).

¹⁹⁶ “Concerns and entities are affiliates of each other when one controls or has the power to control the other, or a third party or parties controls or has the power to control both. It does not matter whether control is exercised, so long as the power to control exists.” 13 C.F.R. § 121.103(a)(1) (an SBA regulation).

¹⁹⁷ 13 C.F.R. § 121.102(b) (an SBA regulation).

¹⁹⁸ 13 C.F.R. 121.201, NAICS codes 515112 and 515120.

¹⁹⁹ See *FCC News Release*, “Broadcast Station Totals as of December 31, 2011,” dated January 6, 2012; http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0106/DOC-311837A1.pdf.

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meet the Small Business Act's definition of a "small business concern" because they are not independently owned and operated.²⁰⁰

Multichannel Video Distribution and Data Service. MVDDS is a terrestrial fixed microwave service operating in the 12.2-12.7 GHz band. The Commission adopted criteria for defining three groups of small businesses for purposes of determining their eligibility for special provisions such as bidding credits. It defines a very small business as an entity with average annual gross revenues not exceeding \$3 million for the preceding three years; a small business as an entity with average annual gross revenues not exceeding \$15 million for the preceding three years; and an entrepreneur as an entity with average annual gross revenues not exceeding \$40 million for the preceding three years.²⁰¹ These definitions were approved by the SBA.²⁰² On January 27, 2004, the Commission completed an auction of 214 MVDDS licenses (Auction No. 53). In this auction, ten winning bidders won a total of 192 MVDDS licenses.²⁰³ Eight of the ten winning bidders claimed small business status and won 144 of the licenses. The Commission also held an auction of MVDDS licenses on December 7, 2005 (Auction 63). Of the three winning bidders who won 22 licenses, two winning bidders, winning 21 of the licenses, claimed small business status.²⁰⁴

Amateur Radio Service. These licensees are held by individuals in a noncommercial capacity; these licensees are not small entities.

Personal Radio Services. Personal radio services provide short-range, low power radio for personal communications, radio signaling, and business communications not provided for in other services. The Personal Radio Services include spectrum licensed under Part 95 of our rules.²⁰⁵ These services include Citizen Band Radio Service ("CB"), General Mobile Radio Service ("GMRS"), Radio Control Radio Service ("R/C"), Family Radio Service ("FRS"), Wireless Medical Telemetry Service ("WMTS"), Medical Implant Communications Service ("MICS"), Low Power Radio Service ("LPRS"), and Multi-Use Radio Service ("MURS").²⁰⁶ There are a variety of methods used to license the spectrum in these rule parts, from licensing by rule, to conditioning operation on successful completion of a required test, to site-based licensing, to geographic area licensing. Under the RFA, the Commission is required to make a

²⁰⁰ See 15 U.S.C. § 632.

²⁰¹ *Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range; Amendment of the Commission's Rules to Authorize Subsidiary Terrestrial Use of the 12.2-12.7 GHz Band by Direct Broadcast Satellite Licenses and their Affiliates; and Applications of Broadwave USA, PDC Broadband Corporation, and Satellite Receivers, Ltd. to provide A Fixed Service in the 12.2-12.7 GHz Band*, ET Docket No. 98-206, Memorandum Opinion and Order and Second Report and Order, 17 FCC Rcd 9614, 9711, ¶ 252 (2002).

²⁰² See Letter from Hector V. Barreto, Administrator, U.S. Small Business Administration, to Margaret W. Wiener, Chief, Auctions and Industry Analysis Division, WTB, FCC (Feb.13, 2002).

²⁰³ See "Multichannel Video Distribution and Data Service Auction Closes," Public Notice, 19 FCC Rcd 1834 (2004).

²⁰⁴ See "Auction of Multichannel Video Distribution and Data Service Licenses Closes; Winning Bidders Announced for Auction No. 63," Public Notice, 20 FCC Rcd 19807 (2005).

²⁰⁵ 47 C.F.R. part 90.

²⁰⁶ The Citizens Band Radio Service, General Mobile Radio Service, Radio Control Radio Service, Family Radio Service, Wireless Medical Telemetry Service, Medical Implant Communications Service, Low Power Radio Service, and Multi-Use Radio Service are governed by subpart D, subpart A, subpart C, subpart B, subpart H, subpart I, subpart G, and subpart J, respectively, of part 95 of the Commission's rules. See generally 47 C.F.R. part 95.

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determination of which small entities are directly affected by the rules being proposed. Since all such entities are wireless, we apply the definition of Wireless Telecommunications Carriers (except Satellite), pursuant to which a small entity is defined as employing 1,500 or fewer persons.²⁰⁷ Many of the licensees in these services are individuals, and thus are not small entities. In addition, due to the mostly unlicensed and shared nature of the spectrum utilized in many of these services, the Commission lacks direct information upon which to base an estimation of the number of small entities under an SBA definition that might be directly affected by our action.

Public Safety Radio Services. Public Safety radio services include police, fire, local government, forestry conservation, highway maintenance, and emergency medical services.²⁰⁸ There are a total of approximately 127,540 licensees in these services. Governmental entities²⁰⁹ as well as private businesses comprise the licensees for these services. All governmental entities with populations of less than 50,000 fall within the definition of a small entity.²¹⁰

IMTS Resale Carriers. Providers of IMTS resale services are common carriers that purchase IMTS from other carriers and resell it to their own customers. Under that size standard, such a business is small if it has 1,500 or fewer employees.²¹¹ Census data for 2007 show that 1,523 firms provided resale services during that year. Of that number, 1,522 operated with fewer than 1000 employees and one operated with more than 1,000.²¹² Thus under this category and the associated small business size standard, the majority of these local resellers can be considered small entities. According to Commission data, 213 carriers have reported that they are engaged in the provision of local resale services.²¹³ Of these, an estimated 211 have 1,500 or fewer employees and two have more than 1,500 employees.²¹⁴ Consequently, the Commission estimates that the majority of IMTS resellers are small entities that may be affected by our action.

²⁰⁷ 13 C.F.R. § 121.201, NAICS Code 517210.

²⁰⁸ With the exception of the special emergency service, these services are governed by subpart B of part 90 of the Commission's Rules, 47 C.F.R. §§ 90.15-90.27. The police service includes approximately 27,000 licensees that serve state, county, and municipal enforcement through telephony (voice), telegraphy (code) and teletype and facsimile (printed material). The fire radio service includes approximately 23,000 licensees comprised of private volunteer or professional fire companies as well as units under governmental control. The local government service is presently comprised of approximately 41,000 licensees that are state, county, or municipal entities that use the radio for official purposes not covered by other public safety services. There are approximately 7,000 licensees within the forestry service which is comprised of licensees from state departments of conservation and private forest organizations who set up communications networks among fire lookout towers and ground crews. The approximately 9,000 state and local governments are licensed for highway maintenance service to provide emergency and routine communications to aid other public safety services to keep main roads safe for vehicular traffic. The approximately 1,000 licensees in the Emergency Medical Radio Service ("EMRS") use the 39 channels allocated to this service for emergency medical service communications related to the delivery of emergency medical treatment. 47 C.F.R. §§ 90.15-90.27. The approximately 20,000 licensees in the special emergency service include medical services, rescue organizations, veterinarians, handicapped persons, disaster relief organizations, school buses, beach patrols, establishments in isolated areas, communications standby facilities, and emergency repair of public communications facilities. 47 C.F.R. §§ 90.33-90.55.

²⁰⁹ 47 C.F.R. § 1.1162.

²¹⁰ 5 U.S.C. § 601(5).

²¹¹ 13 C.F.R. § 121.201, NAICS code 517911.

²¹² http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-_skip=800&-ds_name=EC0751SSSZ5&-_lang=en.

²¹³ See *Trends in Telephone Service*, at tbl. 5.3.

²¹⁴ *Id.*

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Wireless Carriers and Service Providers. Included among the providers of IMTS resale are a number of wireless carriers that also provide wireless telephony services domestically. The Commission classifies these entities as providers of Commercial Mobile Radio Services (CMRS). At present, most, if not all, providers of CMRS that offer IMTS provide such service by purchasing IMTS from other carriers to resell it to their customers. The Commission has not developed a size standard specifically for CMRS providers that offer resale IMTS. Such entities would fall within the larger category of wireless carriers and service providers. For those services subject to auctions, the Commission notes that, as a general matter, the number of winning bidders that qualify as small businesses at the close of an auction does not necessarily represent the number of small businesses currently in service. Also, the Commission does not generally track subsequent business size unless, in the context of assignments or transfers, unjust enrichment issues are implicated.

D. Description of Projected Reporting, Recordkeeping, and Other Compliance Requirements

The amendments being made in this *Order* do not change reporting requirements but may require additional training consistent with industry RF safety program standards regarding compliance with our RF exposure limits for certain transmitting facilities, such as broadcast sites, some wireless base stations and some antennas at multiple transmitter sites. Also, we are clarifying that in order for the occupational/controlled SAR or MPE limits to be used in evaluating compliance for a portable or mobile device, certain conditions must be met that may include placing a visual advisory such as a label on a device that provides a user with specific information on RF exposure. We are also requiring a sample of the advisory and instructional material be filed with the Commission along with the application for equipment authorization.

E. Steps Taken to Minimize Significant Economic Impact on Small Entities, and Significant Alternatives Considered

The RFA requires an agency to describe any significant alternatives that it has considered in reaching its proposed approach, which may include the following four alternatives (among others): (1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance or reporting requirements under the rule for small entities; (3) the use of performance, rather than design, standards; and (4) an exemption from coverage of the rule, or any part thereof, for small entities.²¹⁵

F. Federal Rules that May Duplicate, Overlap, or Conflict with the Proposed Rule

The Commission will send a copy of the *Order*, including this FRFA, in a report to be sent to Congress pursuant to the SBREFA.²¹⁶ In addition, the Commission will send a copy of the *Order*, including the FRFA, to the Chief Counsel for Advocacy of the SBA. A copy of the *Order* and the FRFA (or summaries thereof) will also be published in the Federal Register.²¹⁷

²¹⁵ 5 U.S.C. § 603(c).

²¹⁶ See 5 U.S.C. § 801(a) (1) (A).

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APPENDIX F

Initial Regulatory Flexibility Analysis

As required by the Regulatory Flexibility Act of 1980 (RFA),¹ the Commission has prepared this Initial Regulatory Flexibility Analysis (IRFA) of the possible significant economic impact on small entities by the policies and rules proposed in this *Further Notice of Proposed Rule Making (Further Notice)*. Written public comments are requested on this IRFA. Comments must be identified as responses to the IRFA and must be filed by the deadlines for comments provided in paragraph 254 in this *Further Notice*. The Commission will send a copy of this *Further Notice*, including this IRFA, to the Chief Counsel for Advocacy of the Small Business Administration (SBA).² In addition, the *Further Notice* and IRFA (or summaries thereof) will be published in the Federal Register.³

A. Need for, and Objectives of, the Proposed Rules.

The National Environmental Policy Act of 1969 (NEPA) requires agencies of the Federal Government to evaluate the effects of their actions on the quality of the human environment.⁴ To meet its responsibilities under NEPA, the Commission has adopted requirements for evaluating the environmental impact of its actions. One of several environmental factors addressed by these requirements is human exposure to radiofrequency (RF) energy emitted by FCC-regulated transmitters, facilities and devices.⁵

The *Notice* proposes to amend Parts 1, 2, 15, 24, 25, 95 and 97 of our rules relating to the compliance of FCC-regulated transmitters, facilities, and devices with the guidelines for human exposure to radiofrequency (RF) energy adopted by the Commission in 1996 and 1997. Specifically we are proposing to make certain revisions in our rules that we believe will result in more efficient, practical and consistent application of compliance procedures.

B. Legal Basis.

The proposed action is authorized under Sections 1, 4(i), 4(j), 301, 303(r), 307, 308, 309, 332(a)(1), 332(c)(7)(B)(iv), and 403 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 151, 154(i), 154(j), 301, 303(r), 307, 308, 309, 332(a)(1), 332(c)(7)(B)(iv), 403; the National Environmental Policy Act of 1969, 42 U.S.C. § 4321, *et seq.*; Section 704(b) of the Telecommunications Act of 1996, Pub. L. No. 104-104; and Section 553 of the Administrative Procedure Act, 5 U.S.C. § 553.

C. Description and Estimate of the Number of Small Entities To Which the Proposed Rules Will Apply.

The RFA directs agencies to provide a description of, and where feasible, an estimate of the number of small entities that may be affected by the proposed rules and policies, if adopted.⁶ The RFA generally defines the term “small entity” as having the same meaning as the terms “small business,” “small

¹ See 5 U.S.C. § 603. The RFA, *see* 5 U.S.C. § 601 - 612, has been amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), Pub. L. No. 104-121, 110 Stat. 857 (1996).

² See 5 U.S.C. § 603(a).

³ *Id.*

⁴ National Environmental Policy Act of 1969, as amended, 42 U.S.C. 4321-4335.

⁵ See 47 CFR 1.1307(b).

⁶ 5 U.S.C. § 603(b)(3).

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organization,” and “small governmental jurisdiction.”⁷ In addition, the term “small business” has the same meaning as the term “small business concern” under the Small Business Act.⁸ A “small business concern” is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the SBA.⁹

Small Businesses. Nationwide, there are a total of approximately 29.6 million small businesses, according to the SBA.¹⁰

Small Businesses, Small Organizations, and Small Governmental Jurisdictions. Our action may, over time, affect small entities that are not easily categorized at present. We therefore describe here, at the outset, three comprehensive, statutory small entity size standards.¹¹ First, nationwide, there are a total of approximately 27.5 million small businesses, according to the SBA.¹² In addition, a “small organization” is generally “any not-for-profit enterprise which is independently owned and operated and is not dominant in its field.”¹³ Nationwide, as of 2007, there were approximately 1,621,315 small organizations.¹⁴ Finally, the term “small governmental jurisdiction” is defined generally as “governments of cities, towns, townships, villages, school districts, or special districts, with a population of less than fifty thousand.”¹⁵ Census Bureau data for 2011 indicate that there were 89,476 local governmental jurisdictions in the United States.¹⁶ We estimate that, of this total, as many as 88,506 entities may qualify as “small governmental jurisdictions.”¹⁷ Thus, we estimate that most governmental jurisdictions are small.

⁷ 5 U.S.C. § 601(6).

⁸ 5 U.S.C. § 601(3) (incorporating by reference the definition of “small-business concern” in the Small Business Act, 15 U.S.C. § 632). Pursuant to 5 U.S.C. § 601(3), the statutory definition of a small business applies “unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register.”

⁹ 15 U.S.C. § 632.

¹⁰ See SBA, Office of Advocacy, “Frequently Asked Questions,” <http://web.sba.gov/faqs> (accessed Jan. 2009).

¹¹ See 5 U.S.C. §§ 601(3)–(6).

¹² See SBA, Office of Advocacy, “Frequently Asked Questions,” web.sba.gov/faqs (last visited May 6, 2011; figures are from 2009).

¹³ 5 U.S.C. § 601(4).

¹⁴ INDEPENDENT SECTOR, THE NEW NONPROFIT ALMANAC & DESK REFERENCE (2010).

¹⁵ 5 U.S.C. § 601(5).

¹⁶ U.S. CENSUS BUREAU, STATISTICAL ABSTRACT OF THE UNITED STATES: 2011, Table 427 (2007)

¹⁷ The 2007 U.S. Census data for small governmental organizations indicate that there were 89,476 “Local Governments” in 2007. (U.S. CENSUS BUREAU, STATISTICAL ABSTRACT OF THE UNITED STATES 2011, Table 428.) The criterion by which the size of such local governments is determined to be small is a population of 50,000. However, since the Census Bureau does not specifically apply that criterion, it cannot be determined with precision how many of such local governmental organizations is small. Nonetheless, the inference seems reasonable that substantial number of these governmental organizations has a population of less than 50,000. To look at Table 428 in conjunction with a related set of data in Table 429 in the Census’s Statistical Abstract of the U.S., that inference is further supported by the fact that in both Tables, many entities that may well be small are included in the 89,476 local governmental organizations, e.g. county, municipal, township and town, school district and special district entities. Measured by a criterion of a population of 50,000 many specific sub-entities in this category seem more likely than larger county-level governmental organizations to have small populations. Accordingly, of the 89,476 small governmental organizations identified in the 2007 Census, the Commission estimates that a substantial majority is small. 17 13 C.F.R. § 121.201, NAICS code 517110.

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Experimental Radio Service (Other Than Broadcast). The majority of experimental licenses are issued to companies such as Motorola and Department of Defense contractors such as Northrop, Lockheed and Martin Marietta. Businesses such as these may have as many as 200 licenses at one time. The majority of these applications are from entities such as these. Given this fact, the remaining 30 percent of applications, we assume, for purposes of our evaluations and conclusions in this FRFA, will be awarded to small entities, as that term is defined by the SBA.

The Commission processes approximately 1,000 applications a year for experimental radio operations. About half or 500 of these are renewals and the other half are for new licenses. We do not have adequate information to predict precisely how many of these applications will be impacted by our rule revisions. However, based on the above figures we estimate that as many as 300 of these applications could be from small entities and potentially could be impacted.

International Broadcast Stations. Commission records show that there are 19 international high frequency broadcast station authorizations. We do not request nor collect annual revenue information, and are unable to estimate the number of international high frequency broadcast stations that would constitute a small business under the SBA definition. Since all international broadcast stations operate using relatively high power levels, it is likely that they could all be impacted by our proposed rule revisions.

Satellite Telecommunications Providers. Two economic census categories address the satellite industry. The first category has a small business size standard of \$15 million or less in average annual receipts, under SBA rules.¹⁸ The second has a size standard of \$25 million or less in annual receipts.¹⁹ The category of Satellite Telecommunications “comprises establishments primarily engaged in providing telecommunications services to other establishments in the telecommunications and broadcasting industries by forwarding and receiving communications signals via a system of satellites or reselling satellite telecommunications.”²⁰ Census Bureau data for 2007 show that 512 Satellite Telecommunications firms that operated for that entire year.²¹ Of this total, 464 firms had annual receipts of under \$10 million, and 18 firms had receipts of \$10 million to \$24,999,999.²² Consequently, the Commission estimates that the majority of Satellite Telecommunications firms are small entities that might be affected by our proposals.

The second category, i.e. “All Other Telecommunications” comprises “establishments primarily engaged in providing specialized telecommunications services, such as satellite tracking, communications telemetry, and radar station operation. This industry also includes establishments primarily engaged in providing satellite terminal stations and associated facilities connected with one or more terrestrial systems and capable of transmitting telecommunications to, and receiving telecommunications from, satellite systems. Establishments providing Internet services or voice over Internet protocol (VoIP) services via client-supplied telecommunications connections are also included in this industry.”²³ For this category, Census Bureau data for 2007 shows that there were a total of 2,383 firms that operated for the

¹⁸ 13 C.F.R. § 121.201, NAICS code 517410.

¹⁹ 13 C.F.R. § 121.201, NAICS code 517919.

²⁰ U.S. Census Bureau, 2007 NAICS Definitions, 517410 Satellite Telecommunications.

²¹ See http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-_skip=900&-ds_name=EC0751SSSZ4&-_lang=en.

²² See http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-_skip=900&-ds_name=EC0751SSSZ4&-_lang=en.

²³ <http://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517919&search=2007%20NAICS%20Search>.

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entire year.²⁴ Of this total, 2,347 firms had annual receipts of under \$25 million and 12 firms had annual receipts of \$25 million to \$49, 999,999.²⁵ Consequently, the Commission estimates that the majority of All Other Telecommunications firms are small entities that might be affected by our action.

Fixed Satellite Transmit/Receive Earth Stations. There are approximately 4,303 earth station authorizations, a portion of which are Fixed Satellite Transmit/Receive Earth Stations. We do not request nor collect annual revenue information, and are unable to estimate the number of the earth stations that would constitute a small business under the SBA definition. However, the majority of these stations could be impacted by our proposed rules.

Fixed Satellite Small Transmit/Receive Earth Stations. There are approximately 4,303 earth station authorizations, a portion of which are Fixed Satellite Small Transmit/Receive Earth Stations. We do not request nor collect annual revenue information, and are unable to estimate the number of fixed small satellite transmit/receive earth stations that would constitute a small business under the SBA definition. However, the majority of these stations could be impacted by our proposed rules.

Fixed Satellite Very Small Aperture Terminal (VSAT) Systems. These stations operate on a primary basis, and frequency coordination with terrestrial microwave systems is not required. Thus, a single "blanket" application may be filed for a specified number of small antennas and one or more hub stations. There are 492 current VSAT System authorizations. We do not request nor collect annual revenue information, and are unable to estimate the number of VSAT systems that would constitute a small business under the SBA definition. However, it is expected that many of these stations could be impacted by our proposed rules.

Mobile Satellite Earth Stations. There are 19 licensees. We do not request nor collect annual revenue information, and are unable to estimate the number of mobile satellite earth stations that would constitute a small business under the SBA definition. However, it is expected that many of these stations could be impacted by our proposed rules.

Wireless Telecommunications Carriers (except satellite). This industry comprises establishments engaged in operating and maintaining switching and transmission facilities to provide communications via the airwaves. Establishments in this industry have spectrum licenses and provide services using that spectrum, such as cellular phone services, paging services, wireless Internet access, and wireless video services.²⁶ The appropriate size standard under SBA rules is for the category Wireless Telecommunications Carriers. The size standard for that category is that a business is small if it has 1,500 or fewer employees.²⁷ Under the present and prior categories, the SBA has deemed a wireless business to be small if it has 1,500 or fewer employees.²⁸ For this category, census data for 2007 show that there were 1,383 firms that operated for the entire year.²⁹ Of this total, 1,368 firms had employment of 999 or

²⁴ http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-_skip=900&-ds_name=EC0751SSSZ4&-_lang=en.

²⁵ http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-_skip=900&-ds_name=EC0751SSSZ4&-_lang=en.

²⁶ <http://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517210&search=2007%20NAICS%20Search>

²⁷ 13 C.F.R. § 121.201, NAICS code 517210.

²⁸ 13 C.F.R. § 121.201, NAICS code 517210. The now-superseded, pre-2007 C.F.R. citations were 13 C.F.R. § 121.201, NAICS codes 517211 and 517212 (referring to the 2002 NAICS).

²⁹ U.S. Census Bureau, Subject Series: Information, Table 5, "Establishment and Firm Size: Employment Size of Firms for the United States: 2007 NAICS Code 517210" (issued Nov. 2010).

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fewer employees and 15 had employment of 1000 employees or more.³⁰ Thus under this category and the associated small business size standard, the Commission estimates that the majority of wireless telecommunications carriers(except satellite) are small entities that may be affected by our proposed action.³¹

Licenses Assigned by Auctions. Initially, we note that, as a general matter, the number of winning bidders that qualify as small businesses at the close of an auction does not necessarily represent the number of small businesses currently in service. Also, the Commission does not generally track subsequent business size unless, in the context of assignments or transfers, unjust enrichment issues are implicated.

Paging Services. Neither the SBA nor the FCC has developed a definition applicable exclusively to paging services. However, a variety of paging services is now categorized under Wireless Telecommunications Carriers (except satellite).³² This industry comprises establishments engaged in operating and maintaining switching and transmission facilities to provide communications via the airwaves. Establishments in this industry have spectrum licenses and provide services using that spectrum, such as cellular phone services, paging services, wireless Internet access, and wireless video services. Illustrative examples in the paging context include paging services, except satellite; two-way paging communications carriers, except satellite; and radio paging services communications carriers. The SBA has deemed a paging service in this category to be small if it has 1,500 or fewer employees.³³ For this category, census data for 2007 show that there were 1,383 firms that operated for the entire year.³⁴ Of this total, 1,368 firms had employment of 999 or fewer employees and 15 had employment of 1000 employees or more.³⁵ Thus under this category and the associated small business size standard, the Commission estimates that the majority of paging services in the category of wireless telecommunications carriers(except satellite) are small entities that may be affected by our proposed action.³⁶ In addition, in the Paging Second Report and Order, the Commission adopted a size standard for “small businesses” for purposes of determining their eligibility for special provisions such as bidding credits.³⁷ A small business is an entity that, together with its affiliates and controlling principals, has average gross

³⁰ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “100 employees or more.”

³¹ See http://factfinder.census.gov/servlet/IBQTable?_bm=y&-fds_name=EC0700A1&-geo_id=&-skip=600&-ds_name=EC0751SSSZ5&-lang=en

³² U.S. Census Bureau, 2007 NAICS Definitions, “517210 Wireless Telecommunications Categories (Except Satellite)”; <http://www.census.gov/naics/2007/def/ND517210.HTM#N517210>

³³ U.S. Census Bureau, 2007 NAICS Definitions, “517210 Wireless Telecommunications Categories (Except Satellite)”

³⁴ U.S. Census Bureau, Subject Series: Information, Table 5, “Establishment and Firm Size: Employment Size of Firms for the United States: 2007 NAICS Code 517210” (issued Nov. 2010).

³⁵ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “100 employees or more.”

³⁶ See http://factfinder.census.gov/servlet/IBQTable?_bm=y&-fds_name=EC0700A1&-geo_id=&-skip=600&-ds_name=EC0751SSSZ5&-lang=en

³⁷ *Revision of Part 22 and Part 90 of the Commission’s Rules to Facilitate Future Development of Paging Systems*, Second Report and Order, 12 FCC Rcd 2732, 2811-2812, paras. 178-181 (“*Paging Second Report and Order*”); see also *Revision of Part 22 and Part 90 of the Commission’s Rules to Facilitate Future Development of Paging Systems*, Memorandum Opinion and Order on Reconsideration, 14 FCC Rcd 10030, 10085-10088, ¶¶ 98-107 (1999).

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revenues not exceeding \$15 million for the preceding three years.³⁸ The SBA has approved this definition.³⁹ An initial auction of Metropolitan Economic Area (“MEA”) licenses was conducted in the year 2000. Of the 2,499 licenses auctioned, 985 were sold.⁴⁰ Fifty-seven companies claiming small business status won 440 licenses.⁴¹ A subsequent auction of MEA and Economic Area (“EA”) licenses was held in the year 2001. Of the 15,514 licenses auctioned, 5,323 were sold.⁴² One hundred thirty-two companies claiming small business status purchased 3,724 licenses. A third auction, consisting of 8,874 licenses in each of 175 EAs and 1,328 licenses in all but three of the 51 MEAs, was held in 2003. Seventy-seven bidders claiming small or very small business status won 2,093 licenses.⁴³ A fourth auction of 9,603 lower and upper band paging licenses was held in the year 2010. 29 bidders claiming small or very small business status won 3,016 licenses.

2.3 GHz Wireless Communications Services. This service can be used for fixed, mobile, radiolocation, and digital audio broadcasting satellite uses. The Commission defined “small business” for the wireless communications services (“WCS”) auction as an entity with average gross revenues of \$40 million for each of the three preceding years, and a “very small business” as an entity with average gross revenues of \$15 million for each of the three preceding years.⁴⁴ The SBA approved these definitions.⁴⁵ The Commission conducted an auction of geographic area licenses in the WCS service in 1997. In the auction, seven bidders that qualified as very small business entities won 31 licenses, and one bidder that qualified as a small business entity won a license.

1670-1675 MHz Services. This service can be used for fixed and mobile uses, except aeronautical mobile.⁴⁶ An auction for one license in the 1670-1675 MHz band was conducted in 2003. The Commission defined a “small business” as an entity with attributable average annual gross revenues of not more than \$40 million for the preceding three years, which would thus be eligible for a 15 percent discount on its winning bid for the 1670-1675 MHz band license. Further, the Commission defined a “very small business” as an entity with attributable average annual gross revenues of not more than \$15 million for the preceding three years, which would thus be eligible to receive a 25 percent discount on its winning bid for the 1670-1675 MHz band license. The winning bidder was not a small entity.

Wireless Telephony. Wireless telephony includes cellular, personal communications services, and specialized mobile radio telephony carriers. As noted, the SBA has developed a small business size

³⁸ *Paging Second Report and Order*, 12 FCC Rcd at 2811, ¶ 179.

³⁹ See Letter from Aida Alvarez, Administrator, SBA, to Amy Zoslov, Chief, Auctions and Industry Analysis Division, Wireless Telecommunications Bureau (“WTB”), FCC (Dec. 2, 1998) (“*Alvarez Letter 1998*”).

⁴⁰ See “929 and 931 MHz Paging Auction Closes,” Public Notice, 15 FCC Rcd 4858 (WTB 2000).

⁴¹ See *id.*

⁴² See “Lower and Upper Paging Band Auction Closes,” Public Notice, 16 FCC Rcd 21821 (WTB 2002).

⁴³ See “Lower and Upper Paging Bands Auction Closes,” Public Notice, 18 FCC Rcd 11154 (WTB 2003). The current number of small or very small business entities that hold wireless licenses may differ significantly from the number of such entities that won in spectrum auctions due to assignments and transfers of licenses in the secondary market over time. In addition, some of the same small business entities may have won licenses in more than one auction.

⁴⁴ *Amendment of the Commission’s Rules to Establish Part 27, the Wireless Communications Service (WCS)*, Report and Order, 12 FCC Rcd 10785, 10879, para. 194 (1997).

⁴⁵ See *Alvarez Letter 1998*.

⁴⁶ 47 C.F.R. § 2.106; see generally 47 C.F.R. §§ 27.1–.70.

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standard for Wireless Telecommunications Carriers (except Satellite).⁴⁷ Under the SBA small business size standard, a business is small if it has 1,500 or fewer employees.⁴⁸ Census data for 2007 shows that there were 1,383 firms that operated that year.⁴⁹ Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus under this category and the associated small business size standard, the majority of firms can be considered small. According to Trends in Telephone Service data, 434 carriers reported that they were engaged in wireless telephony.⁵⁰ Of these, an estimated 222 have 1,500 or fewer employees and 212 have more than 1,500 employees.⁵¹ Therefore, approximately half of these entities can be considered small. Similarly, according to Commission data, 413 carriers reported that they were engaged in the provision of wireless telephony, including cellular service, Personal Communications Service (PCS), and Specialized Mobile Radio (SMR) Telephony services.⁵² Of these, an estimated 261 have 1,500 or fewer employees and 152 have more than 1,500 employees.⁵³ Consequently, the Commission estimates that approximately half or more of these firms can be considered small. Thus, using available data, we estimate that the majority of wireless firms can be considered small.

Broadband Personal Communications Service. *Broadband Personal Communications Service.* The broadband personal communications services (PCS) spectrum is divided into six frequency blocks designated A through F, and the Commission has held auctions for each block. The Commission initially defined a “small business” for C- and F-Block licenses as an entity that has average gross revenues of \$40 million or less in the three previous years.⁵⁴ For F-Block licenses, an additional small business size standard for “very small business” was added and is defined as an entity that, together with its affiliates, has average gross revenues of not more than \$15 million for the preceding three years.⁵⁵ These small business size standards, in the context of broadband PCS auctions, have been approved by the SBA.⁵⁶ No small businesses within the SBA-approved small business size standards bid successfully for licenses in Blocks A and B. There were 90 winning bidders that claimed small business status in the first two C-Block auctions. A total of 93 bidders that claimed small and very small business status won approximately 40 percent of the 1,479 licenses in the first auction for the D, E, and F Blocks.⁵⁷ On April 15, 1999, the Commission completed the re-auction of 347 C-, D-, E-, and F-Block licenses in Auction

⁴⁷ 13 C.F.R. § 121.201, NAICS code 517210.

⁴⁸ *Id.*

⁴⁹ U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-_skip=700&-ds_name=EC0751SSSZ5&-_lang=en.

⁵⁰ *Trends in Telephone Service*, at tbl. 5.3.

⁵¹ *Id.*

⁵² *See Trends in Telephone Service*, at tbl. 5.3.

⁵³ *See id.*

⁵⁴ *See Amendment of Parts 20 and 24 of the Commission's Rules – Broadband PCS Competitive Bidding and the Commercial Mobile Radio Service Spectrum Cap; Amendment of the Commission's Cellular/PCS Cross-Ownership Rule*, WT Docket No. 96-59, GN Docket No. 90-314, Report and Order, 11 FCC Rcd 7824, 7850–52 ¶¶ 57–60 (1996) (“PCS Report and Order”); *see also* 47 C.F.R. § 24.720(b).

⁵⁵ *See PCS Report and Order*, 11 FCC Rcd at 7852 ¶ 60.

⁵⁶ *See Alvarez Letter 1998*.

⁵⁷ *See Broadband PCS, D, E and F Block Auction Closes*, Public Notice, Doc. No. 89838 (rel. Jan. 14, 1997).

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No. 22.⁵⁸ Of the 57 winning bidders in that auction, 48 claimed small business status and won 277 licenses.

On January 26, 2001, the Commission completed the auction of 422 C and F Block Broadband PCS licenses in Auction No. 35. Of the 35 winning bidders in that auction, 29 claimed small business status.⁵⁹ Subsequent events concerning Auction 35, including judicial and agency determinations, resulted in a total of 163 C and F Block licenses being available for grant. On February 15, 2005, the Commission completed an auction of 242 C-, D-, E-, and F-Block licenses in Auction No. 58. Of the 24 winning bidders in that auction, 16 claimed small business status and won 156 licenses.⁶⁰ On May 21, 2007, the Commission completed an auction of 33 licenses in the A, C, and F Blocks in Auction No. 71.⁶¹ Of the 14 winning bidders in that auction, six claimed small business status and won 18 licenses.⁶² On August 20, 2008, the Commission completed the auction of 20 C-, D-, E-, and F-Block Broadband PCS licenses in Auction No. 78.⁶³ Of the eight winning bidders for Broadband PCS licenses in that auction, six claimed small business status and won 14 licenses.⁶⁴

Advanced Wireless Services. In 2006, the Commission conducted its first auction of Advanced Wireless Services licenses in the 1710-1755 MHz and 2110-2155 MHz bands (“AWS-1”), designated as Auction 66.⁶⁵ For the AWS-1 bands, the Commission has defined a “small business” as an entity with average annual gross revenues for the preceding three years not exceeding \$40 million, and a “very small business” as an entity with average annual gross revenues for the preceding three years not exceeding \$15 million.⁶⁶ In 2006, the Commission conducted its first auction of AWS-1 licenses.⁶⁷ In that initial AWS-

⁵⁸ See *C, D, E, and F Block Broadband PCS Auction Closes*, Public Notice, 14 FCC Rcd 6688 (WTB 1999). Before Auction No. 22, the Commission established a very small standard for the C Block to match the standard used for F Block. *Amendment of the Commission’s Rules Regarding Installment Payment Financing for Personal Communications Services (PCS) Licensees*, WT Docket No. 97-82, Fourth Report and Order, 13 FCC Rcd 15743, 15768 ¶ 46 (1998).

⁵⁹ See *C and F Block Broadband PCS Auction Closes; Winning Bidders Announced*, Public Notice, 16 FCC Rcd 2339 (2001).

⁶⁰ See *Broadband PCS Spectrum Auction Closes; Winning Bidders Announced for Auction No. 58*, Public Notice, 20 FCC Rcd 3703 (2005).

⁶¹ See *Auction of Broadband PCS Spectrum Licenses Closes; Winning Bidders Announced for Auction No. 71*, Public Notice, 22 FCC Rcd 9247 (2007).

⁶² *Id.*

⁶³ See *Auction of AWS-1 and Broadband PCS Licenses Closes; Winning Bidders Announced for Auction 78*, Public Notice, 23 FCC Rcd 12749 (WTB 2008).

⁶⁴ *Id.*

⁶⁵ See *Auction of Advanced Wireless Services Licenses Scheduled for June 29, 2006; Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments and Other Procedures for Auction No. 66*, AU Docket No. 06-30, *Public Notice*, 21 FCC Rcd 4562 (2006) (“*Auction 66 Procedures Public Notice*”);

⁶⁶ See *Service Rules for Advanced Wireless Services in the 1.7 GHz and 2.1 GHz Bands, Report and Order*, 18 FCC Rcd 25,162, App. B (2003), *modified by* *Service Rules for Advanced Wireless Services In the 1.7 GHz and 2.1 GHz Bands, Order on Reconsideration*, 20 FCC Rcd 14,058, App. C (2005).

⁶⁷ See *Auction of Advanced Wireless Services Licenses Scheduled for June 29, 2006; Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments and Other Procedures for Auction No. 66*, AU Docket No. 06-30, *Public Notice*, 21 FCC Rcd 4562 (2006) (“*Auction 66 Procedures Public Notice*”).

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1 auction, 31 winning bidders identified themselves as very small businesses won 142 licenses.⁶⁸ Twenty-six of the winning bidders identified themselves as small businesses and won 73 licenses.⁶⁹ In a subsequent 2008 auction, the Commission offered 35 AWS-1 licenses.⁷⁰ Four winning bidders identified themselves as very small businesses, and three of the winning bidders identifying themselves as a small businesses won five AWS-1 licenses.⁷¹

Narrowband Personal Communications Services. In 1994, the Commission conducted two auctions of Narrowband PCS licenses. For these auctions, the Commission defined a “small business” as an entity with average annual gross revenues for the preceding three years not exceeding \$40 million.⁷² Through these auctions, the Commission awarded a total of 41 licenses, 11 of which were obtained by four small businesses.⁷³ To ensure meaningful participation by small business entities in future auctions, the Commission adopted a two-tiered small business size standard in the *Narrowband PCS Second Report and Order*.⁷⁴ A “small business” is an entity that, together with affiliates and controlling interests, has average gross revenues for the three preceding years of not more than \$40 million.⁷⁵ A “very small business” is an entity that, together with affiliates and controlling interests, has average gross revenues for the three preceding years of not more than \$15 million.⁷⁶ The SBA has approved these small business size standards.⁷⁷ A third auction of Narrowband PCS licenses was conducted in 2001. In that auction, five bidders won 317 (Metropolitan Trading Areas and nationwide) licenses.⁷⁸ Three of the winning bidders claimed status as a small or very small entity and won 311 licenses.

Lower 700 MHz Band Licenses. The Commission previously adopted criteria for defining three groups of small businesses for purposes of determining their eligibility for special provisions such as bidding credits.⁷⁹ The Commission defined a “small business” as an entity that, together with its affiliates and

⁶⁸ See *Auction of Advanced Wireless Services Licenses Closes; Winning Bidders Announced for Auction No. 66*, Public Notice, 21 FCC Rcd 10,521 (2006) (“*Auction 66 Closing Public Notice*”).

⁶⁹ See *id.*

⁷⁰ See *AWS-1 and Broadband PCS Procedures Public Notice*, 23 FCC Rcd at 7499. Auction 78 also included an auction of broadband PCS licenses.

⁷¹ See *Auction of AWS-1 and Broadband PCS Licenses Closes, Winning Bidders Announced for Auction 78, Down Payments Due September 9, 2008, FCC Forms 601 and 602 Due September 9, 2008, Final Payments Due September 23, 2008, Ten-Day Petition to Deny Period*, Public Notice, 23 FCC Rcd 12,749 (2008).

⁷² *Implementation of Section 309(j) of the Communications Act – Competitive Bidding Narrowband PCS*, Third Memorandum Opinion and Order and Further Notice of Proposed Rulemaking, 10 FCC Rcd 175, 196, para. 46 (1994).

⁷³ See “Announcing the High Bidders in the Auction of Ten Nationwide Narrowband PCS Licenses, Winning Bids Total \$617,006,674,” *Public Notice*, PNWL 94-004 (rel. Aug. 2, 1994); “Announcing the High Bidders in the Auction of 30 Regional Narrowband PCS Licenses; Winning Bids Total \$490,901,787,” *Public Notice*, PNWL 94-27 (rel. Nov. 9, 1994).

⁷⁴ *Amendment of the Commission’s Rules to Establish New Personal Communications Services, Narrowband PCS, Second Report and Order and Second Further Notice of Proposed Rule Making*, 15 FCC Rcd 10456, 10476, para. 40 (2000) (“*Narrowband PCS Second Report and Order*”).

⁷⁵ *Narrowband PCS Second Report and Order*, 15 FCC Rcd at 10476, para. 40.

⁷⁶ *Id.*

⁷⁷ See *Alvarez Letter 1998*.

⁷⁸ See “Narrowband PCS Auction Closes,” *Public Notice*, 16 FCC Rcd 18663 (WTB 2001).

⁷⁹ See *Reallocation and Service Rules for the 698-746 MHz Spectrum Band (Television Channels 52-59)*, Report and Order, 17 FCC Rcd 1022 (2002) (“*Channels 52-59 Report and Order*”).

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controlling principals, has average gross revenues not exceeding \$40 million for the preceding three years.⁸⁰ A “very small business” is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues that are not more than \$15 million for the preceding three years.⁸¹ Additionally, the Lower 700 MHz Service had a third category of small business status for Metropolitan/Rural Service Area (“MSA/RSA”) licenses —“entrepreneur”— which is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues that are not more than \$3 million for the preceding three years.⁸² The SBA approved these small size standards.⁸³ An auction of 740 licenses was conducted in 2002 (one license in each of the 734 MSAs/RSAs and one license in each of the six Economic Area Groupings (EAGs)). Of the 740 licenses available for auction, 484 licenses were won by 102 winning bidders. Seventy-two of the winning bidders claimed small business, very small business, or entrepreneur status and won a total of 329 licenses.⁸⁴ A second auction commenced on May 28, 2003, closed on June 13, 2003, and included 256 licenses.⁸⁵ Seventeen winning bidders claimed small or very small business status and won 60 licenses, and nine winning bidders claimed entrepreneur status and won 154 licenses.⁸⁶ In 2005, the Commission completed an auction of 5 licenses in the lower 700 MHz band (Auction 60). All three winning bidders claimed small business status.

In 2007, the Commission reexamined its rules governing the 700 MHz band in the *700 MHz Second Report and Order*.⁸⁷ An auction of A, B and E block licenses in the Lower 700 MHz band was held in 2008.⁸⁸ Twenty winning bidders claimed small business status (those with attributable average annual gross revenues that exceed \$15 million and do not exceed \$40 million for the preceding three years). Thirty three winning bidders claimed very small business status (those with attributable average annual gross revenues that do not exceed \$15 million for the preceding three years). In 2011, the Commission conducted Auction 92, which offered 16 lower 700 MHz band licenses that had been made available in Auction 73 but either remained unsold or were licenses on which a winning bidder defaulted. Two of the seven winning bidders in Auction 92 claimed very small business status, winning a total of four licenses.

⁸⁰ See *Channels 52-59 Report and Order*, 17 FCC Rcd at 1087-88, ¶ 172.

⁸¹ See *id.*

⁸² See *id.*, 17 FCC Rcd at 1088, ¶ 173.

⁸³ See Letter from Aida Alvarez, Administrator, SBA, to Thomas Sugrue, Chief, WTB, FCC (Aug. 10, 1999) (“*Alvarez Letter 1999*”).

⁸⁴ See “Lower 700 MHz Band Auction Closes,” *Public Notice*, 17 FCC Rcd 17272 (WTB 2002).

⁸⁵ See Lower 700 MHz Band Auction Closes, *Public Notice*, 18 FCC Rcd 11873 (WTB 2003).

⁸⁶ See *id.*

⁸⁷ Service Rules for the 698-746, 747-762 and 777-792 MHz Band, WT Docket No. 06-150, *Revision of the Commission’s Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems*, CC Docket No. 94-102, Section 68.4(a) of the Commission’s Rules Governing Hearing Aid-Compatible Telephone, WT Docket No. 01-309, *Biennial Regulatory Review – Amendment of Parts 1, 22, 24, 27, and 90 to Streamline and Harmonize Various Rules Affecting Wireless Radio Services*, WT Docket No. 03-264, *Former Nextel Communications, Inc. Upper 700 MHz Guard Band Licenses and Revisions to Part 27 of the Commission’s Rules*, WT Docket No. 06-169, *Implementing a Nationwide, Broadband Interoperable Public Safety Network in the 700 MHz Band*, PS Docket No. 06-229, *Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State, and Local Public Safety Communications Requirements Through the Year 2010*, WT Docket No. 96-86, *Second Report and Order*, 22 FCC Rcd 15289 (2007) (“*700 MHz Second Report and Order*”).

⁸⁸ See Auction of 700 MHz Band Licenses Closes, *Public Notice*, 23 FCC Rcd 4572 (WTB 2008).

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Upper 700 MHz Band Licenses. In the *700 MHz Second Report and Order*, the Commission revised its rules regarding Upper 700 MHz licenses.⁸⁹ On January 24, 2008, the Commission commenced Auction 73 in which several licenses in the Upper 700 MHz band were available for licensing: 12 Regional Economic Area Grouping licenses in the C Block, and one nationwide license in the D Block.⁹⁰ The auction concluded on March 18, 2008, with 3 winning bidders claiming very small business status (those with attributable average annual gross revenues that do not exceed \$15 million for the preceding three years) and winning five licenses.

700 MHz Guard Band Licenses. In 2000, the Commission adopted the *700 MHz Guard Band Report and Order*, in which it established rules for the A and B block licenses in the Upper 700 MHz band, including size standards for “small businesses” and “very small businesses” for purposes of determining their eligibility for special provisions such as bidding credits.⁹¹ A small business in this service is an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$40 million for the preceding three years.⁹² Additionally, a very small business is an entity that, together with its affiliates and controlling principals, has average gross revenues that are not more than \$15 million for the preceding three years.⁹³ SBA approval of these definitions is not required.⁹⁴ An auction of these licenses was conducted in 2000.⁹⁵ Of the 104 licenses auctioned, 96 licenses were won by nine bidders. Five of these bidders were small businesses that won a total of 26 licenses. A second auction of 700 MHz Guard Band licenses was held in 2001. All eight of the licenses auctioned were sold to three bidders. One of these bidders was a small business that won a total of two licenses.⁹⁶

Specialized Mobile Radio. The Commission adopted small business size standards for the purpose of determining eligibility for bidding credits in auctions of Specialized Mobile Radio (SMR) geographic area licenses in the 800 MHz and 900 MHz bands. The Commission defined a “small business” as an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$15 million for the preceding three years.⁹⁷ The Commission defined a “very small business” as an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$3 million for the preceding three years.⁹⁸ The SBA has approved these small business size standards for both the 800 MHz and 900 MHz SMR Service.⁹⁹ The first 900 MHz SMR auction was completed in 1996. Sixty bidders claiming that they qualified as small businesses under the \$15 million size standard

⁸⁹ *700 MHz Second Report and Order*, 22 FCC Rcd 15289.

⁹⁰ *See Auction of 700 MHz Band Licenses Closes*, Public Notice, 23 FCC Rcd 4572 (WTB 2008).

⁹¹ *See Service Rules for the 746-764 MHz Bands, and Revisions to Part 27 of the Commission's Rules*, Second Report and Order, 15 FCC Rcd 5299 (2000) (“*700 MHz Guard Band Report and Order*”).

⁹² *See 700 MHz Guard Band Report and Order*, 15 FCC Rcd at 5343, para. 108.

⁹³ *See id.*

⁹⁴ *See id.*, 15 FCC Rcd 5299, 5343, para. 108 n.246 (for the 746-764 MHz and 776-794 MHz bands, the Commission is exempt from 15 U.S.C. § 632, which requires Federal agencies to obtain SBA approval before adopting small business size standards).

⁹⁵ *See “700 MHz Guard Bands Auction Closes: Winning Bidders Announced,” Public Notice*, 15 FCC Rcd 18026 (2000).

⁹⁶ *See “700 MHz Guard Bands Auction Closes: Winning Bidders Announced,” Public Notice*, 16 FCC Rcd 4590 (WTB 2001).

⁹⁷ 47 C.F.R. §§ 90.810, 90.814(b), 90.912.

⁹⁸ 47 C.F.R. §§ 90.810, 90.814(b), 90.912.

⁹⁹ *See Alvarez Letter 1999*.

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won 263 licenses in the 900 MHz SMR band. In 2004, the Commission held a second auction of 900 MHz SMR licenses and three winning bidders identifying themselves as very small businesses won 7 licenses.¹⁰⁰ The auction of 800 MHz SMR licenses for the upper 200 channels was conducted in 1997. Ten bidders claiming that they qualified as small or very small businesses under the \$15 million size standard won 38 licenses for the upper 200 channels.¹⁰¹ A second auction of 800 MHz SMR licenses was conducted in 2002 and included 23 BEA licenses. One bidder claiming small business status won five licenses.¹⁰²

The auction of the 1,053 800 MHz SMR licenses for the General Category channels was conducted in 2000. Eleven bidders who won 108 licenses for the General Category channels in the 800 MHz SMR band qualified as small or very small businesses.¹⁰³ In an auction completed in 2000, a total of 2,800 Economic Area licenses in the lower 80 channels of the 800 MHz SMR service were awarded.¹⁰⁴ Of the 22 winning bidders, 19 claimed small or very small business status and won 129 licenses. Thus, combining all four auctions, 41 winning bidders for geographic licenses in the 800 MHz SMR band claimed to be small businesses.

In addition, there are numerous incumbent site-by-site SMR licensees and licensees with extended implementation authorizations in the 800 and 900 MHz bands. We do not know how many firms provide 800 MHz or 900 MHz geographic area SMR pursuant to extended implementation authorizations, nor how many of these providers have annual revenues not exceeding \$15 million. One firm has over \$15 million in revenues. In addition, we do not know how many of these firms have 1500 or fewer employees.¹⁰⁵ We assume, for purposes of this analysis, that all of the remaining existing extended implementation authorizations are held by small entities, as that small business size standard is approved by the SBA.

220 MHz Radio Service – Phase I Licensees. The 220 MHz service has both Phase I and Phase II licenses. Phase I licensing was conducted by lotteries in 1992 and 1993. There are approximately 1,515 such non-nationwide licensees and four nationwide licensees currently authorized to operate in the 220 MHz band. The Commission has not developed a small business size standard for small entities specifically applicable to such incumbent 220 MHz Phase I licensees. To estimate the number of such licensees that are small businesses, the Commission applies the small business size standard under the SBA rules applicable. The SBA has deemed a wireless business to be small if it has 1,500 or fewer employees.¹⁰⁶ For this service, the SBA uses the category of Wireless Telecommunications Carriers (except Satellite). Census data for 2007, which supersede data contained in the 2002 Census, show that

¹⁰⁰ See 900 MHz Specialized Mobile Radio Service Spectrum Auction Closes: Winning Bidders Announced,” *Public Notice*, 19 FCC Rcd. 3921 (WTB 2004).

¹⁰¹ See “Correction to Public Notice DA 96-586 ‘FCC Announces Winning Bidders in the Auction of 1020 Licenses to Provide 900 MHz SMR in Major Trading Areas,’” *Public Notice*, 18 FCC Rcd 18367 (WTB 1996).

¹⁰² See “Multi-Radio Service Auction Closes,” *Public Notice*, 17 FCC Rcd 1446 (WTB 2002).

¹⁰³ See “800 MHz Specialized Mobile Radio (SMR) Service General Category (851-854 MHz) and Upper Band (861-865 MHz) Auction Closes; Winning Bidders Announced,” *Public Notice*, 15 FCC Rcd 17162 (2000).

¹⁰⁴ See, “800 MHz SMR Service Lower 80 Channels Auction Closes; Winning Bidders Announced,” *Public Notice*, 16 FCC Rcd 1736 (2000).

¹⁰⁵ See generally 13 C.F.R. § 121.201, NAICS code 517210.

¹⁰⁶ 13 C.F.R. § 121.201, NAICS code 517210 (2007 NAICS). The now-superseded, pre-2007 C.F.R. citations were 13 C.F.R. § 121.201, NAICS codes 517211 and 517212 (referring to the 2002 NAICS).

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there were 1,383 firms that operated that year.¹⁰⁷ Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus under this category and the associated small business size standard, the majority of firms can be considered small.

220 MHz Radio Service – Phase II Licensees. The 220 MHz service has both Phase I and Phase II licenses. The Phase II 220 MHz service licenses are assigned by auction, where mutually exclusive applications are accepted. In the *220 MHz Third Report and Order*, the Commission adopted a small business size standard for defining “small” and “very small” businesses for purposes of determining their eligibility for special provisions such as bidding credits.¹⁰⁸ This small business standard indicates that a “small business” is an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$15 million for the preceding three years.¹⁰⁹ A “very small business” is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues that do not exceed \$3 million for the preceding three years.¹¹⁰ The SBA has approved these small size standards.¹¹¹ Auctions of Phase II licenses commenced on and closed in 1998.¹¹² In the first auction, 908 licenses were auctioned in three different-sized geographic areas: three nationwide licenses, 30 Regional Economic Area Group (EAG) Licenses, and 875 Economic Area (EA) Licenses. Of the 908 licenses auctioned, 693 were sold.¹¹³ Thirty-nine small businesses won 373 licenses in the first 220 MHz auction. A second auction included 225 licenses: 216 EA licenses and 9 EAG licenses. Fourteen companies claiming small business status won 158 licenses.¹¹⁴ A third auction included four licenses: 2 BEA licenses and 2 EAG licenses in the 220 MHz Service. No small or very small business won any of these licenses.¹¹⁵ In 2007, the Commission conducted a fourth auction of the 220 MHz licenses, designated as Auction 72.¹¹⁶ Auction 72, which offered 94 Phase II 220 MHz Service licenses, concluded in 2007.¹¹⁷ In this auction, five winning bidders won a total of 76 licenses. Two winning bidders identified themselves as very small businesses won 56 of the 76 licenses. One of the winning bidders that identified themselves as a small business won 5 of the 76 licenses won.

¹⁰⁷ U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-skip=700&-ds_name=EC0751SSSZ5&-_lang=en.

¹⁰⁸ *Amendment of Part 90 of the Commission’s Rules to Provide For the Use of the 220-222 MHz Band by the Private Land Mobile Radio Service*, Third Report and Order, 12 FCC Rcd 10943, 11068-70 ¶¶ 291-295 (1997).

¹⁰⁹ *Id.* at 11068 ¶ 291.

¹¹⁰ *Id.*

¹¹¹ See Letter to Daniel Phythyon, Chief, Wireless Telecommunications Bureau, Federal Communications Commission, from Aida Alvarez, Administrator, Small Business Administration, dated January 6, 1998 (*Alvarez to Phythyon Letter 1998*).

¹¹² See generally *220 MHz Service Auction Closes*, Public Notice, 14 FCC Rcd 605 (WTB 1998).

¹¹³ See *FCC Announces It is Prepared to Grant 654 Phase II 220 MHz Licenses After Final Payment is Made*, Public Notice, 14 FCC Rcd 1085 (WTB 1999).

¹¹⁴ See *Phase II 220 MHz Service Spectrum Auction Closes*, Public Notice, 14 FCC Rcd 11218 (WTB 1999).

¹¹⁵ See *Multi-Radio Service Auction Closes*, Public Notice, 17 FCC Rcd 1446 (WTB 2002).

¹¹⁶ See “Auction of Phase II 220 MHz Service Spectrum Scheduled for June 20, 2007, Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments and Other Procedures for Auction 72, *Public Notice*, 22 FCC Rcd 3404 (2007).

¹¹⁷ See *Auction of Phase II 220 MHz Service Spectrum Licenses Closes, Winning Bidders Announced for Auction 72, Down Payments due July 18, 2007, FCC Forms 601 and 602 due July 18, 2007, Final Payments due August 1, 2007, Ten-Day Petition to Deny Period*, Public Notice, 22 FCC Rcd 11573 (2007).

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Private Land Mobile Radio (“PLMR”). PLMR systems serve an essential role in a range of industrial, business, land transportation, and public safety activities. These radios are used by companies of all sizes operating in all U.S. business categories, and are often used in support of the licensee’s primary (non-telecommunications) business operations. For the purpose of determining whether a licensee of a PLMR system is a small business as defined by the SBA, we use the broad census category, Wireless Telecommunications Carriers (except Satellite). This definition provides that a small entity is any such entity employing no more than 1,500 persons.¹¹⁸ The Commission does not require PLMR licensees to disclose information about number of employees, so the Commission does not have information that could be used to determine how many PLMR licensees constitute small entities under this definition. We note that PLMR licensees generally use the licensed facilities in support of other business activities, and therefore, it would also be helpful to assess PLMR licensees under the standards applied to the particular industry subsector to which the licensee belongs.¹¹⁹

As of March 2010, there were 424,162 PLMR licensees operating 921,909 transmitters in the PLMR bands below 512 MHz. We note that any entity engaged in a commercial activity is eligible to hold a PLMR license, and that any revised rules in this context could therefore potentially impact small entities covering a great variety of industries.

Fixed Microwave Services. Microwave services include common carrier,¹²⁰ private-operational fixed,¹²¹ and broadcast auxiliary radio services.¹²² They also include the Local Multipoint Distribution Service (“LMDS”),¹²³ the Digital Electronic Message Service (“DEMS”),¹²⁴ and the 24 GHz Service,¹²⁵ where licensees can choose between common carrier and non-common carrier status.¹²⁶ The Commission has not yet defined a small business with respect to microwave services. For purposes of this IRFA, the Commission will use the SBA’s definition applicable to Wireless Telecommunications Carriers (except satellite)—*i.e.*, an entity with no more than 1,500 persons is considered small.¹²⁷ For the category of Wireless Telecommunications Carriers (except Satellite), Census data for 2007 shows that there were 1,383 firms that operated that year.¹²⁸ Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus under this category and the associated small business size standard, the majority of firms can be considered small. The Commission notes that the number of firms does not

¹¹⁸ See 13 C.F.R. § 121.201, NAICS code 517210.

¹¹⁹ See generally 13 C.F.R. § 121.201.

¹²⁰ See 47 C.F.R. Part 101, Subparts C and I.

¹²¹ See *id.* Subparts C and H.

¹²² Auxiliary Microwave Service is governed by Part 74 of Title 47 of the Commission’s Rules. See 47 C.F.R. Part 74. Available to licensees of broadcast stations and to broadcast and cable network entities, broadcast auxiliary microwave stations are used for relaying broadcast television signals from the studio to the transmitter, or between two points such as a main studio and an auxiliary studio. The service also includes mobile TV pickups, which relay signals from a remote location back to the studio.

¹²³ See 47 C.F.R. Part 101, Subpart L.

¹²⁴ See *id.* Subpart G.

¹²⁵ See *id.*

¹²⁶ See 47 C.F.R. §§ 101.533, 101.1017.

¹²⁷ 13 C.F.R. § 121.201, NAICS code 517210.

¹²⁸ U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-_skip=700&-ds_name=EC0751SSSZ5&-_lang=en.

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necessarily track the number of licensees. The Commission estimates that virtually all of the Fixed Microwave licensees (excluding broadcast auxiliary licensees) would qualify as small entities under the SBA definition.

39 GHz Service. The Commission adopted small business size standards for 39 GHz licenses. A “small business” is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$40 million in the preceding three years.¹²⁹ A “very small business” is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues of not more than \$15 million for the preceding three years.¹³⁰ The SBA has approved these small business size standards.¹³¹ In 2000, the Commission conducted an auction of 2,173 39 GHz licenses. A total of 18 bidders who claimed small or very small business status won 849 licenses.

Local Multipoint Distribution Service. Local Multipoint Distribution Service (“LMDS”) is a fixed broadband point-to-multipoint microwave service that provides for two-way video telecommunications.¹³² The Commission established a small business size standard for LMDS licenses as an entity that has average gross revenues of less than \$40 million in the three previous years.¹³³ An additional small business size standard for “very small business” was added as an entity that, together with its affiliates, has average gross revenues of not more than \$15 million for the preceding three years.¹³⁴ The SBA has approved these small business size standards in the context of LMDS auctions.¹³⁵ There were 93 winning bidders that qualified as small entities in the LMDS auctions. A total of 93 small and very small business bidders won approximately 277 A Block licenses and 387 B Block licenses. In 1999, the Commission re-auctioned 161 licenses; there were 32 small and very small businesses winning that won 119 licenses.

218-219 MHz Service. The first auction of 218-219 MHz Service (previously referred to as the Interactive and Video Data Service or IVDS) licenses resulted in 170 entities winning licenses for 594 Metropolitan Statistical Areas (“MSAs”).¹³⁶ Of the 594 licenses, 557 were won by 167 entities qualifying as a small business. For that auction, the Commission defined a small business as an entity that, together with its affiliates, has no more than a \$6 million net worth and, after federal income taxes (excluding any carry over losses), has no more than \$2 million in annual profits each year for the previous two years.¹³⁷ In the *218-219 MHz Report and Order and Memorandum Opinion and Order*, the Commission revised its small business size standards for the 218-219 MHz Service and defined a small business as an entity that, together with its affiliates and persons or entities that hold interests in such an entity and their affiliates,

¹²⁹ See *Amendment of the Commission's Rules Regarding the 37.0-38.6 GHz and 38.6-40.0 GHz Bands*, ET Docket No. 95-183, Report and Order, 12 FCC Rcd 18600 (1997).

¹³⁰ *Id.*

¹³¹ See Letter from Aida Alvarez, Administrator, SBA, to Kathleen O'Brien Ham, Chief, Auctions and Industry Analysis Division, WTB, FCC (Feb. 4, 1998); see Letter from Hector Barreto, Administrator, SBA, to Margaret Wiener, Chief, Auctions and Industry Analysis Division, WTB, FCC (Jan. 18, 2002).

¹³² See [*Rulemaking to Amend Parts 1, 2, 21, 25, of the Commission's Rules to Redesignate the 27.5-29.5 GHz Frequency Band, Reallocate the 29.5-30.5 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services*](#), CC Docket No. 92-297, Second Report and Order, Order on Reconsideration, and Fifth Notice of Proposed Rule Making, 12 FCC Rcd 12545, 12689-90, para. 348 (1997) (“*LMDS Second Report and Order*”).

¹³³ See [*LMDS Second Report and Order*](#), 12 FCC Rcd at 12689-90, para. 348.

¹³⁴ See *id.*

¹³⁵ See Alvarez to Phythyon Letter 1998.

¹³⁶ See “*Interactive Video and Data Service (IVDS) Applications Accepted for Filing*,” Public Notice, 9 FCC Rcd 6227 (1994).

¹³⁷ *Implementation of Section 309(j) of the Communications Act – Competitive Bidding*, Fourth Report and Order, 9 FCC Rcd 2330 (1994).

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has average annual gross revenues not exceeding \$15 million for the preceding three years.¹³⁸ The Commission defined a “very small business” as an entity that, together with its affiliates and persons or entities that hold interests in such an entity and its affiliates, has average annual gross revenues not exceeding \$3 million for the preceding three years.¹³⁹ The SBA has approved these definitions.¹⁴⁰

Location and Monitoring Service (“LMS”). Multilateration LMS systems use non-voice radio techniques to determine the location and status of mobile radio units. For auctions of LMS licenses, the Commission has defined a “small business” as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the preceding three years not exceeding \$15 million.¹⁴¹ A “very small business” is defined as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the preceding three years not exceeding \$3 million.¹⁴² These definitions have been approved by the SBA.¹⁴³ An auction of LMS licenses was conducted in 1999. Of the 528 licenses auctioned, 289 licenses were sold to four small businesses.

Rural Radiotelephone Service. The Commission has not adopted a size standard for small businesses specific to the Rural Radiotelephone Service.¹⁴⁴ A significant subset of the Rural Radiotelephone Service is the Basic Exchange Telephone Radio System (“BETRS”).¹⁴⁵ For purposes of its analysis of the Rural Radiotelephone Service, the Commission uses the SBA small business size standard for the category “Wireless Telecommunications Carriers (except satellite),” which is 1,500 or fewer employees.¹⁴⁶ Census data for 2007 shows that there were 1,383 firms that operated that year.¹⁴⁷ Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus under this category and the associated small business size standard, the majority of firms in the Rural Radiotelephone Service can be considered small.

Air-Ground Radiotelephone Service.¹⁴⁸ The Commission has previously used the SBA’s small business definition applicable to Wireless Telecommunications Carriers (except Satellite), *i.e.*, an entity employing no more than 1,500 persons.¹⁴⁹ There are approximately 100 licensees in the Air-Ground Radiotelephone Service, and under that definition, we estimate that almost all of them qualify as small entities under the SBA definition. For purposes of assigning Air-Ground Radiotelephone Service licenses

¹³⁸ *Amendment of Part 95 of the Commission’s Rules to Provide Regulatory Flexibility in the 218-219 MHz Service*, Report and Order and Memorandum Opinion and Order, 15 FCC Rcd 1497 (1999).

¹³⁹ *Id.*

¹⁴⁰ *See Alvarez to Phythyon Letter 1998.*

¹⁴¹ *Amendment of Part 90 of the Commission’s Rules to Adopt Regulations for Automatic Vehicle Monitoring Systems*, Second Report and Order, 13 FCC Rcd 15182, 15192, ¶ 20 (1998) (“*Automatic Vehicle Monitoring Systems Second Report and Order*”); *see also* 47 C.F.R. § 90.1103.

¹⁴² *Automatic Vehicle Monitoring Systems Second Report and Order*, 13 FCC Rcd at 15192, para. 20; *see also* 47 C.F.R. § 90.1103.

¹⁴³ *See Alvarez Letter 1998.*

¹⁴⁴ The service is defined in section 22.99 of the Commission’s Rules, 47 C.F.R. § 22.99.

¹⁴⁵ BETRS is defined in sections 22.757 and 22.759 of the Commission’s Rules, 47 C.F.R. §§ 22.757 and 22.759.

¹⁴⁶ 13 C.F.R. § 121.201, NAICS code 517210.

¹⁴⁷ U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-_skip=700&-ds_name=EC0751SSSZ5&-_lang=en.

¹⁴⁸ The service is defined in § 22.99 of the Commission’s Rules, 47 C.F.R. § 22.99.

¹⁴⁹ 13 C.F.R. § 121.201, NAICS codes 517210.

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through competitive bidding, the Commission has defined “small business” as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the preceding three years not exceeding \$40 million.¹⁵⁰ A “very small business” is defined as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the preceding three years not exceeding \$15 million.¹⁵¹ These definitions were approved by the SBA.¹⁵² In 2006, the Commission completed an auction of nationwide commercial Air-Ground Radiotelephone Service licenses in the 800 MHz band (Auction 65). The auction closed with two winning bidders winning two Air-Ground Radiotelephone Services licenses. Neither of the winning bidders claimed small business status.

Aviation and Marine Radio Services. Small businesses in the aviation and marine radio services use a very high frequency (“VHF”) marine or aircraft radio and, as appropriate, an emergency position-indicating radio beacon (and/or radar) or an emergency locator transmitter. The Commission has not developed a small business size standard specifically applicable to these small businesses. For purposes of this analysis, the Commission uses the SBA small business size standard for the category Wireless Telecommunications Carriers (except satellite),” which is 1,500 or fewer employees.¹⁵³ Census data for 2007 shows that there were 1,383 firms that operated that year.¹⁵⁴ Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus under this category and the associated small business size standard, the majority of firms can be considered small.

Offshore Radiotelephone Service. This service operates on several UHF television broadcast channels that are not used for television broadcasting in the coastal areas of states bordering the Gulf of Mexico.¹⁵⁵ There are presently approximately 55 licensees in this service. The Commission is unable to estimate at this time the number of licensees that would qualify as small under the SBA’s small business size standard for the category of Wireless Telecommunications Carriers (except Satellite). Under that standard,¹⁵⁶ Under that SBA small business size standard, a business is small if it has 1,500 or fewer employees.¹⁵⁷ Census data for 2007 shows that there were 1,383 firms that operated that year.¹⁵⁸ Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus under this category and the associated small business size standard, the majority of firms can be considered small.

¹⁵⁰ *Amendment of Part 22 of the Commission’s Rules to Benefit the Consumers of Air-Ground Telecommunications Services, Biennial Regulatory Review – Amendment of Parts 1, 22, and 90 of the Commission’s Rules, Amendment of Parts 1 and 22 of the Commission’s Rules to Adopt Competitive Bidding Rules for Commercial and General Aviation Air-Ground Radiotelephone Service*, WT Docket Nos. 03-103 and 05-42, Order on Reconsideration and Report and Order, 20 FCC Red 19663, ¶¶ 28-42 (2005).

¹⁵¹ *Id.*

¹⁵² See Letter from Hector V. Barreto, Administrator, SBA, to Gary D. Michaels, Deputy Chief, Auctions and Spectrum Access Division, WTB, FCC (Sept. 19, 2005).

¹⁵³ 13 C.F.R. § 121.201, NAICS code 517210.

¹⁵⁴ U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-_skip=700&-ds_name=EC0751SSSZ5&-_lang=en.

¹⁵⁵ This service is governed by Subpart I of Part 22 of the Commission’s Rules. See 47 C.F.R. §§ 22.1001-22.1037.

¹⁵⁶ 13 C.F.R. § 121.201, NAICS code 517210.

¹⁵⁷ *Id.*

¹⁵⁸ U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-_skip=700&-ds_name=EC0751SSSZ5&-_lang=en.

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Multiple Address Systems (“MAS”). Entities using MAS spectrum, in general, fall into two categories: (1) those using the spectrum for profit-based uses, and (2) those using the spectrum for private internal uses. The Commission defines a small business for MAS licenses as an entity that has average gross revenues of less than \$15 million in the preceding three years.¹⁵⁹ A very small business is defined as an entity that, together with its affiliates, has average gross revenues of not more than \$3 million for the preceding three years.¹⁶⁰ The SBA has approved these definitions.¹⁶¹ The majority of these entities will most likely be licensed in bands where the Commission has implemented a geographic area licensing approach that would require the use of competitive bidding procedures to resolve mutually exclusive applications. The Commission’s licensing database indicates that, as of March 5, 2010, there were over 11,500 MAS station authorizations. In 2001, an auction of 5,104 MAS licenses in 176 EAs was conducted.¹⁶² Seven winning bidders claimed status as small or very small businesses and won 611 licenses. In 2005, the Commission completed an auction (Auction 59) of 4,226 MAS licenses in the Fixed Microwave Services from the 928/959 and 932/941 MHz bands. Twenty-six winning bidders won a total of 2,323 licenses. Of the 26 winning bidders in this auction, five claimed small business status and won 1,891 licenses.

With respect to entities that use, or seek to use, MAS spectrum to accommodate internal communications needs, we note that MAS serves an essential role in a range of industrial, safety, business, and land transportation activities. MAS radios are used by companies of all sizes, operating in virtually all U.S. business categories, and by all types of public safety entities. For the majority of private internal users, the small business size standard developed by the SBA would be more appropriate. The applicable size standard in this instance appears to be that of Wireless Telecommunications Carriers (except Satellite). This definition provides that a small entity is any such entity employing no more than 1,500 persons.¹⁶³ The Commission’s licensing database indicates that, as of January 20, 1999, of the 8,670 total MAS station authorizations, 8,410 authorizations were for private radio service, and of these, 1,433 were for private land mobile radio service.

1.4 GHz Band Licensees. The Commission conducted an auction of 64 1.4 GHz band licenses in the paired 1392-1395 MHz and 1432-1435 MHz bands, and in the unpaired 1390-1392 MHz band in 2007.¹⁶⁴ For these licenses, the Commission defined “small business” as an entity that, together with its affiliates and controlling interests, had average gross revenues not exceeding \$40 million for the preceding three years, and a “very small business” as an entity that, together with its affiliates and controlling interests, has had average annual gross revenues not exceeding \$15 million for the preceding three years.¹⁶⁵ Neither of the two winning bidders claimed small business status.¹⁶⁶

¹⁵⁹ See *Amendment of the Commission’s Rules Regarding Multiple Address Systems*, Report and Order, 15 FCC Rcd 11956, 12008, ¶ 123 (2000).

¹⁶⁰ *Id.*

¹⁶¹ See *Alvarez Letter 1999*.

¹⁶² See “*Multiple Address Systems Spectrum Auction Closes*,” Public Notice, 16 FCC Rcd 21011 (2001).

¹⁶³ See 13 C.F.R. § 121.201, NAICS code 517210.

¹⁶⁴ See “*Auction of 1.4 GHz Band Licenses Scheduled for February 7, 2007*,” Public Notice, 21 FCC Rcd 12393 (WTB 2006); “*Auction of 1.4 GHz Band Licenses Closes; Winning Bidders Announced for Auction No. 69*,” Public Notice, 22 FCC Rcd 4714 (2007) (“*Auction No. 69 Closing PN*”).

¹⁶⁵ *Auction No. 69 Closing PN*, Attachment C.

¹⁶⁶ See *Auction No. 69 Closing PN*.

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Incumbent 24 GHz Licensees. This analysis may affect incumbent licensees who were relocated to the 24 GHz band from the 18 GHz band, and applicants who wish to provide services in the 24 GHz band. For this service, the Commission uses the SBA small business size standard for the category “Wireless Telecommunications Carriers (except satellite),” which is 1,500 or fewer employees.¹⁶⁷ To gauge small business prevalence for these cable services we must, however, use the most current census data. Census data for 2007 shows that there were 1,383 firms that operated that year.¹⁶⁸ Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus under this category and the associated small business size standard, the majority of firms can be considered small. The Commission notes that the Census’ use of the classifications “firms” does not track the number of “licenses”. The Commission believes that there are only two licensees in the 24 GHz band that were relocated from the 18 GHz band, Teligent¹⁶⁹ and TRW, Inc. It is our understanding that Teligent and its related companies have less than 1,500 employees, though this may change in the future. TRW is not a small entity. Thus, only one incumbent licensee in the 24 GHz band is a small business entity.

Future 24 GHz Licensees. With respect to new applicants for licenses in the 24 GHz band, for the purpose of determining eligibility for bidding credits, the Commission established three small business definitions. An “entrepreneur” is defined as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the three preceding years not exceeding \$40 million.¹⁷⁰ A “small business” is defined as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the three preceding years not exceeding \$15 million.¹⁷¹ A “very small business” in the 24 GHz band is defined as an entity that, together with controlling interests and affiliates, has average gross revenues not exceeding \$3 million for the preceding three years.¹⁷² The SBA has approved these small business size standards.¹⁷³ In a 2004 auction of 24 GHz licenses, three winning bidders won seven licenses.¹⁷⁴ Two of the winning bidders were very small businesses that won five licenses.

Broadband Radio Service and Educational Broadband Service. Broadband Radio Service systems, previously referred to as Multipoint Distribution Service (“MDS”) and Multichannel Multipoint Distribution Service (“MMDS”) systems, and “wireless cable,” transmit video programming to subscribers and provide two-way high speed data operations using the microwave frequencies of the Broadband Radio Service (“BRS”) and Educational Broadband Service (“EBS”) (previously referred to as

¹⁶⁷ 13 C.F.R. § 121.201, NAICS code 517210.

¹⁶⁸ U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-_skip=700&-ds_name=EC0751SSSZ5&-_lang=en.

¹⁶⁹ Teligent acquired the DEMS licenses of FirstMark, the only licensee other than TRW in the 24 GHz band whose license has been modified to require relocation to the 24 GHz band.

¹⁷⁰ *Amendments to Parts 1, 2, 87 and 101 of the Commission’s Rules To License Fixed Services at 24 GHz*, Report and Order, 15 FCC Rcd 16934, 16967 ¶ 77 (2000) (“24 GHz Report and Order”); see also 47 C.F.R. § 101.538(a)(3).

¹⁷¹ *24 GHz Report and Order*, 15 FCC Rcd at 16967 ¶ 77; see also 47 C.F.R. § 101.538(a)(2).

¹⁷² *24 GHz Report and Order*, 15 FCC Rcd at 16967 ¶ 77; see also 47 C.F.R. § 101.538(a)(1).

¹⁷³ See Letter to Margaret W. Wiener, Deputy Chief, Auctions and Industry Analysis Division, Wireless Telecommunications Bureau, FCC, from Gary M. Jackson, Assistant Administrator, SBA (July 28, 2000).

¹⁷⁴ *Auction of 24 GHz Service Spectrum Auction Closes, Winning Bidders Announced for Auction 56, Down Payments Due August 16, 2004, Final Payments Due August 30, 2004, Ten-Day Petition to Deny Period*, Public Notice, 19 FCC Rcd 14738 (2004).

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the Instructional Television Fixed Service (“ITFS”).¹⁷⁵ In connection with the 1996 BRS auction, the Commission established a small business size standard as an entity that had annual average gross revenues of no more than \$40 million in the previous three years.¹⁷⁶ The BRS auctions resulted in 67 successful bidders obtaining licensing opportunities for 493 Basic Trading Areas (“BTAs”). Of the 67 auction winners, 61 met the definition of a small business. BRS also includes licensees of stations authorized prior to the auction. At this time, we estimate that of the 61 small business BRS auction winners, 48 remain small business licensees. In addition to the 48 small businesses that hold BTA authorizations, there are approximately 392 incumbent BRS licensees that are considered small entities.¹⁷⁷ After adding the number of small business auction licensees to the number of incumbent licensees not already counted, we find that there are currently approximately 440 BRS licensees that are defined as small businesses under either the SBA or the Commission’s rules. In 2009, the Commission conducted Auction 86, the sale of 78 licenses in the BRS areas.¹⁷⁸ The Commission offered three levels of bidding credits: (i) a bidder with attributed average annual gross revenues that exceed \$15 million and do not exceed \$40 million for the preceding three years (small business) will receive a 15 percent discount on its winning bid; (ii) a bidder with attributed average annual gross revenues that exceed \$3 million and do not exceed \$15 million for the preceding three years (very small business) will receive a 25 percent discount on its winning bid; and (iii) a bidder with attributed average annual gross revenues that do not exceed \$3 million for the preceding three years (entrepreneur) will receive a 35 percent discount on its winning bid.¹⁷⁹ Auction 86 concluded in 2009 with the sale of 61 licenses.¹⁸⁰ Of the ten winning bidders, two bidders that claimed small business status won 4 licenses; one bidder that claimed very small business status won three licenses; and two bidders that claimed entrepreneur status won six licenses.

In addition, the SBA’s Cable Television Distribution Services small business size standard is applicable to EBS. There are presently 2,032 EBS licensees. All but 100 of these licenses are held by educational institutions. Educational institutions are included in this analysis as small entities.¹⁸¹ Thus, we estimate that at least 1,932 licensees are small businesses. Since 2007, Cable Television Distribution Services have been defined within the broad economic census category of Wired Telecommunications Carriers; that category is defined as follows: “This industry comprises establishments primarily engaged in operating and/or providing access to transmission facilities and infrastructure that they own and/or lease for the transmission of voice, data, text, sound, and video using wired telecommunications networks.

¹⁷⁵ *Amendment of Parts 21 and 74 of the Commission’s Rules with Regard to Filing Procedures in the Multipoint Distribution Service and in the Instructional Television Fixed Service and Implementation of Section 309(j) of the Communications Act—Competitive Bidding*, MM Docket No. 94-131, PP Docket No. 93-253, Report and Order, 10 FCC Rcd 9589, 9593 ¶ 7 (1995).

¹⁷⁶ 47 C.F.R. § 21.961(b)(1).

¹⁷⁷ 47 U.S.C. § 309(j). Hundreds of stations were licensed to incumbent MDS licensees prior to implementation of Section 309(j) of the Communications Act of 1934, 47 U.S.C. § 309(j). For these pre-auction licenses, the applicable standard is SBA’s small business size standard of 1500 or fewer employees.

¹⁷⁸ *Auction of Broadband Radio Service (BRS) Licenses, Scheduled for October 27, 2009, Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments, and Other Procedures for Auction 86*, Public Notice, 24 FCC Rcd 8277 (2009).

¹⁷⁹ *Id.* at 8296.

¹⁸⁰ *Auction of Broadband Radio Service Licenses Closes, Winning Bidders Announced for Auction 86, Down Payments Due November 23, 2009, Final Payments Due December 8, 2009, Ten-Day Petition to Deny Period*, Public Notice, 24 FCC Rcd 13572 (2009).

¹⁸¹ The term “small entity” within SBREFA applies to small organizations (nonprofits) and to small governmental jurisdictions (cities, counties, towns, townships, villages, school districts, and special districts with populations of less than 50,000). 5 U.S.C. §§ 601(4)–(6). We do not collect annual revenue data on EBS licensees.

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Transmission facilities may be based on a single technology or a combination of technologies.”¹⁸² For these services, the Commission uses the SBA small business size standard for the category “Wireless Telecommunications Carriers (except satellite),” which is 1,500 or fewer employees.¹⁸³ To gauge small business prevalence for these cable services we must, however, use the most current census data. According to Census Bureau data for 2007, there were a total of 955 firms in this previous category that operated for the entire year.¹⁸⁴ Of this total, 939 firms employed 999 or fewer employees, and 16 firms employed 1,000 employees or more.¹⁸⁵ Thus, the majority of these firms can be considered small.

Television Broadcasting. This Economic Census category “comprises establishments primarily engaged in broadcasting images together with sound. These establishments operate television broadcasting studios and facilities for the programming and transmission of programs to the public.”¹⁸⁶ The SBA has created the following small business size standard for Television Broadcasting firms: those having \$14 million or less in annual receipts.¹⁸⁷ The Commission has estimated the number of licensed commercial television stations to be 1,387.¹⁸⁸ In addition, according to Commission staff review of the BIA Advisory Services, LLC’s *Media Access Pro Television Database* on March 28, 2012, about 950 of an estimated 1,300 commercial television stations (or approximately 73 percent) had revenues of \$14 million or less.¹⁸⁹ We therefore estimate that the majority of commercial television broadcasters are small entities.

We note, however, that in assessing whether a business concern qualifies as small under the above definition, business (control) affiliations¹⁹⁰ must be included. Our estimate, therefore, likely overstates the number of small entities that might be affected by our action because the revenue figure on which it is based does not include or aggregate revenues from affiliated companies. In addition, an element of the definition of “small business” is that the entity not be dominant in its field of operation. We are unable at this time to define or quantify the criteria that would establish whether a specific television station is dominant in its field of operation. Accordingly, the estimate of small businesses to which rules may apply does not exclude any television station from the definition of a small business on this basis and is therefore possibly over-inclusive to that extent.

In addition, the Commission has estimated the number of licensed noncommercial educational (NCE) television stations to be 396.¹⁹¹ These stations are non-profit, and therefore considered to be small entities.¹⁹²

¹⁸² U.S. Census Bureau, 2007 NAICS Definitions, 517110 Wired Telecommunications Carriers, (partial definition), www.census.gov/naics/2007/def/ND517110.HTM#N517110.

¹⁸³ 13 C.F.R. § 121.201, NAICS code 517210.

¹⁸⁴ U.S. Census Bureau, 2007 Economic Census, Subject Series: Information, Table 5, Employment Size of Firms for the United States: 2007, NAICS code 5171102 (issued November 2010).

¹⁸⁵ *Id.*

¹⁸⁶ U.S. Census Bureau, 2007 NAICS Definitions, “515120 Television Broadcasting” (partial definition); <http://www.census.gov/naics/2007/def/ND515120.HTM#N515120>.

¹⁸⁷ 13 C.F.R. § 121.201, NAICS code 515120 (updated for inflation in 2010).

¹⁸⁸ See *FCC News Release*, “Broadcast Station Totals as of December 31, 2011,” dated January 6, 2012; http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-311837A1.pdf.

¹⁸⁹ We recognize that BIA’s estimate differs slightly from the FCC total given *supra*.

¹⁹⁰ “[Business concerns] are affiliates of each other when one concern controls or has the power to control the other or a third party or parties controls or has to power to control both.” 13 C.F.R. § 21.103(a)(1).

¹⁹¹ See *FCC News Release*, “Broadcast Station Totals as of December 31, 2011,” dated January 6, 2012; http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0106/DOC-311837A1.pdf.

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In addition, there are also 2,528 low power television stations, including Class A stations (LPTV).¹⁹³ Given the nature of these services, we will presume that all LPTV licensees qualify as small entities under the above SBA small business size standard.

Radio Broadcasting. This Economic Census category “comprises establishments primarily engaged in broadcasting aural programs by radio to the public. Programming may originate in their own studio, from an affiliated network, or from external sources.”¹⁹⁴ The SBA has established a small business size standard for this category, which is: such firms having \$7 million or less in annual receipts.¹⁹⁵ According to Commission staff review of BIA Advisory Services, LLC’s *Media Access Pro Radio Database* on March 28, 2012, about 10,759 (97%) of 11,102 commercial radio stations had revenues of \$7 million or less. Therefore, the majority of such entities are small entities.

We note, however, that in assessing whether a business concern qualifies as small under the above size standard, business affiliations must be included.¹⁹⁶ In addition, to be determined to be a “small business,” the entity may not be dominant in its field of operation.¹⁹⁷ We note that it is difficult at times to assess these criteria in the context of media entities, and our estimate of small businesses may therefore be over-inclusive.

Auxiliary, Special Broadcast and Other Program Distribution Services. This service involves a variety of transmitters, generally used to relay broadcast programming to the public (through translator and booster stations) or within the program distribution chain (from a remote news gathering unit back to the station). The Commission has not developed a definition of small entities applicable to broadcast auxiliary licensees. The applicable definitions of small entities are those, noted previously, under the SBA rules applicable to radio broadcasting stations and television broadcasting stations.¹⁹⁸

The Commission estimates that there are approximately 6,099 FM translators and boosters.¹⁹⁹ The Commission does not collect financial information on any broadcast facility, and the Department of Commerce does not collect financial information on these auxiliary broadcast facilities. We believe that most, if not all, of these auxiliary facilities could be classified as small businesses by themselves. We also recognize that most commercial translators and boosters are owned by a parent station which, in some cases, would be covered by the revenue definition of small business entity discussed above. These stations would likely have annual revenues that exceed the SBA maximum to be designated as a small business (\$7.0 million for a radio station or \$14.0 million for a TV station). Furthermore, they do not

(Continued from previous page) _____

¹⁹² See generally 5 U.S.C. §§ 601(4), (6).

¹⁹³ See *FCC News Release*, “Broadcast Station Totals as of December 31, 2011,” dated January 6, 2012; http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0106/DOC-311837A1.pdf.

¹⁹⁴ U.S. Census Bureau, 2007 NAICS Definitions, “515112 Radio Stations”; <http://www.census.gov/naics/2007/def/ND515112.HTM#N515112>.

¹⁹⁵ 13 C.F.R. § 121.201, NAICS code 515112 (updated for inflation in 2010).

¹⁹⁶ “Concerns and entities are affiliates of each other when one controls or has the power to control the other, or a third party or parties controls or has the power to control both. It does not matter whether control is exercised, so long as the power to control exists.” 13 C.F.R. § 121.103(a)(1) (an SBA regulation).

¹⁹⁷ 13 C.F.R. § 121.102(b) (an SBA regulation).

¹⁹⁸ 13 C.F.R. 121.201, NAICS codes 515112 and 515120.

¹⁹⁹ See *FCC News Release*, “Broadcast Station Totals as of December 31, 2011,” dated January 6, 2012; http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0106/DOC-311837A1.pdf.

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meet the Small Business Act's definition of a "small business concern" because they are not independently owned and operated.²⁰⁰

Multichannel Video Distribution and Data Service. MVDDS is a terrestrial fixed microwave service operating in the 12.2-12.7 GHz band. The Commission adopted criteria for defining three groups of small businesses for purposes of determining their eligibility for special provisions such as bidding credits. It defines a very small business as an entity with average annual gross revenues not exceeding \$3 million for the preceding three years; a small business as an entity with average annual gross revenues not exceeding \$15 million for the preceding three years; and an entrepreneur as an entity with average annual gross revenues not exceeding \$40 million for the preceding three years.²⁰¹ These definitions were approved by the SBA.²⁰² On January 27, 2004, the Commission completed an auction of 214 MVDDS licenses (Auction No. 53). In this auction, ten winning bidders won a total of 192 MVDDS licenses.²⁰³ Eight of the ten winning bidders claimed small business status and won 144 of the licenses. The Commission also held an auction of MVDDS licenses on December 7, 2005 (Auction 63). Of the three winning bidders who won 22 licenses, two winning bidders, winning 21 of the licenses, claimed small business status.²⁰⁴

Amateur Radio Service. These licensees are held by individuals in a noncommercial capacity; these licensees are not small entities.

Personal Radio Services. Personal radio services provide short-range, low power radio for personal communications, radio signaling, and business communications not provided for in other services. The Personal Radio Services include spectrum licensed under Part 95 of our rules.²⁰⁵ These services include Citizen Band Radio Service ("CB"), General Mobile Radio Service ("GMRS"), Radio Control Radio Service ("R/C"), Family Radio Service ("FRS"), Wireless Medical Telemetry Service ("WMTS"), Medical Implant Communications Service ("MICS"), Low Power Radio Service ("LPRS"), and Multi-Use Radio Service ("MURS").²⁰⁶ There are a variety of methods used to license the spectrum in these rule parts, from licensing by rule, to conditioning operation on successful completion of a required test, to site-based licensing, to geographic area licensing. Under the RFA, the Commission is required to make a

²⁰⁰ See 15 U.S.C. § 632.

²⁰¹ *Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range; Amendment of the Commission's Rules to Authorize Subsidiary Terrestrial Use of the 12.2-12.7 GHz Band by Direct Broadcast Satellite Licenses and their Affiliates; and Applications of Broadwave USA, PDC Broadband Corporation, and Satellite Receivers, Ltd. to provide A Fixed Service in the 12.2-12.7 GHz Band*, ET Docket No. 98-206, Memorandum Opinion and Order and Second Report and Order, 17 FCC Rcd 9614, 9711, ¶ 252 (2002).

²⁰² See Letter from Hector V. Barreto, Administrator, U.S. Small Business Administration, to Margaret W. Wiener, Chief, Auctions and Industry Analysis Division, WTB, FCC (Feb.13, 2002).

²⁰³ See "Multichannel Video Distribution and Data Service Auction Closes," Public Notice, 19 FCC Rcd 1834 (2004).

²⁰⁴ See "Auction of Multichannel Video Distribution and Data Service Licenses Closes; Winning Bidders Announced for Auction No. 63," Public Notice, 20 FCC Rcd 19807 (2005).

²⁰⁵ 47 C.F.R. part 90.

²⁰⁶ The Citizens Band Radio Service, General Mobile Radio Service, Radio Control Radio Service, Family Radio Service, Wireless Medical Telemetry Service, Medical Implant Communications Service, Low Power Radio Service, and Multi-Use Radio Service are governed by subpart D, subpart A, subpart C, subpart B, subpart H, subpart I, subpart G, and subpart J, respectively, of part 95 of the Commission's rules. See generally 47 C.F.R. part 95.

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determination of which small entities are directly affected by the rules being proposed. Since all such entities are wireless, we apply the definition of Wireless Telecommunications Carriers (except Satellite), pursuant to which a small entity is defined as employing 1,500 or fewer persons.²⁰⁷ Many of the licensees in these services are individuals, and thus are not small entities. In addition, due to the mostly unlicensed and shared nature of the spectrum utilized in many of these services, the Commission lacks direct information upon which to base an estimation of the number of small entities under an SBA definition that might be directly affected by our proposed actions.

Public Safety Radio Services. Public Safety radio services include police, fire, local government, forestry conservation, highway maintenance, and emergency medical services.²⁰⁸ There are a total of approximately 127,540 licensees in these services. Governmental entities²⁰⁹ as well as private businesses comprise the licensees for these services. All governmental entities with populations of less than 50,000 fall within the definition of a small entity.²¹⁰

IMTS Resale Carriers. Providers of IMTS resale services are common carriers that purchase IMTS from other carriers and resell it to their own customers. Under that size standard, such a business is small if it has 1,500 or fewer employees.²¹¹ Census data for 2007 show that 1,523 firms provided resale services during that year. Of that number, 1,522 operated with fewer than 1000 employees and one operated with more than 1,000.²¹² Thus under this category and the associated small business size standard, the majority of these local resellers can be considered small entities. According to Commission data, 213 carriers have reported that they are engaged in the provision of local resale services.²¹³ Of these, an estimated 211 have 1,500 or fewer employees and two have more than 1,500 employees.²¹⁴ Consequently, the Commission estimates that the majority of IMTS resellers are small entities that may be affected by our proposed actions.

²⁰⁷ 13 C.F.R. § 121.201, NAICS Code 517210.

²⁰⁸ With the exception of the special emergency service, these services are governed by subpart B of part 90 of the Commission's Rules, 47 C.F.R. §§ 90.15-90.27. The police service includes approximately 27,000 licensees that serve state, county, and municipal enforcement through telephony (voice), telegraphy (code) and teletype and facsimile (printed material). The fire radio service includes approximately 23,000 licensees comprised of private volunteer or professional fire companies as well as units under governmental control. The local government service is presently comprised of approximately 41,000 licensees that are state, county, or municipal entities that use the radio for official purposes not covered by other public safety services. There are approximately 7,000 licensees within the forestry service which is comprised of licensees from state departments of conservation and private forest organizations who set up communications networks among fire lookout towers and ground crews. The approximately 9,000 state and local governments are licensed for highway maintenance service to provide emergency and routine communications to aid other public safety services to keep main roads safe for vehicular traffic. The approximately 1,000 licensees in the Emergency Medical Radio Service ("EMRS") use the 39 channels allocated to this service for emergency medical service communications related to the delivery of emergency medical treatment. 47 C.F.R. §§ 90.15-90.27. The approximately 20,000 licensees in the special emergency service include medical services, rescue organizations, veterinarians, handicapped persons, disaster relief organizations, school buses, beach patrols, establishments in isolated areas, communications standby facilities, and emergency repair of public communications facilities. 47 C.F.R. §§ 90.33-90.55.

²⁰⁹ 47 C.F.R. § 1.1162.

²¹⁰ 5 U.S.C. § 601(5).

²¹¹ 13 C.F.R. § 121.201, NAICS code 517911.

²¹² http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-_skip=800&-ds_name=EC0751SSSZ5&-_lang=en.

²¹³ See *Trends in Telephone Service*, at tbl. 5.3.

²¹⁴ *Id.*

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Wireless Carriers and Service Providers. Included among the providers of IMTS resale are a number of wireless carriers that also provide wireless telephony services domestically. The Commission classifies these entities as providers of Commercial Mobile Radio Services (CMRS). At present, most, if not all, providers of CMRS that offer IMTS provide such service by purchasing IMTS from other carriers to resell it to their customers. The Commission has not developed a size standard specifically for CMRS providers that offer resale IMTS. Such entities would fall within the larger category of wireless carriers and service providers. For those services subject to auctions, the Commission notes that, as a general matter, the number of winning bidders that qualify as small businesses at the close of an auction does not necessarily represent the number of small businesses currently in service. Also, the Commission does not generally track subsequent business size unless, in the context of assignments or transfers, unjust enrichment issues are implicated.

D. Description of Projected Reporting, Recordkeeping, and Other Compliance Requirements

The proposals being made in this *Further Notice*, may require additional analysis and mitigation activities regarding compliance with our RF exposure limits for certain facilities, operations and transmitters, such as some wireless base stations, particularly those on rooftops, and some antennas at multiple transmitter sites. In other cases, current analytical requirements are being relaxed.

E. Steps Taken to Minimize Significant Economic Impact on Small Entities, and Significant Alternatives Considered

The RFA requires an agency to describe any significant alternatives that it has considered in reaching its proposed approach, which may include the following four alternatives (among others): (1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance or reporting requirements under the rule for small entities; (3) the use of performance, rather than design, standards; and (4) an exemption from coverage of the rule, or any part thereof, for small entities.²¹⁵ In this proceeding, our proposals are consistent with (2), in that our goal is making our RF rules more consistent and clarifying certain areas that have created confusion in the past. In addition, due to our revisions in our policy on categorical exclusions, we are providing exemptions from routine RF evaluation for many small entities that should reduce the overall impact on small entities (see number 4 above).

F. Federal Rules that May Duplicate, Overlap, or Conflict With the Proposed Rule

None.

²¹⁵ 5 U.S.C. § 603(c).

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APPENDIX G

List of Commenters

COMMENTS

- (1) American Petroleum Institute (API)
- (2) AT&T Corporation (Kimberly Kantner)
- (3) Broadcast Signal Lab, LLP (BSL)
- (4) Cellular Telecommunications and Internet Association (CTIA)
- (5) Cingular Wireless LLC (Cingular)
- (6) Cisco Systems, Inc. (Cisco)
- (7) Cohen, Dippell and Everist, P.C.
- (8) The EMR Network
- (9) The EMR Policy Institute
- (10) Dell Inc. (Dell)
- (11) Ericsson, Inc., and SONY Ericsson Mobile Communications, Inc. (Ericsson)
- (12) Dave Fry, Intermec
- (13) Garmin International, Inc.
- (14) Global RF Solutions (Global)
- (15) Hammett and Edison, Inc.
- (16) Hatfield and Dawson Consulting Engineers, LLC (Hatfield and Dawson)
- (17) IEEE Local and Metropolitan Area Networks Standards Committee, IEEE 802 (IEEE 802)
- (18) Information Technology Industry Council (ITI)
- (19) IT'IS Foundation, Dr. Niels Kuster (IT'IS)
- (20) Itron, Inc. (Itron)
- (21) Dr. Ronal W. Larson
- (22) Jim Martin
- (23) Roger J. Mattson, Ph.D.
- (24) Motorola, Inc. (Motorola)
- (25) John Moulder, Ph.D., Medical College of Wisconsin
- (26) National Association of Broadcasters (NAB)
- (27) Neviana Nikoloski (for IT'IS Foundation)
- (28) Nokia, Inc. (Nokia)
- (29) palmOne Inc. (palmOne)
- (30) Pinnacle Telecom Group (Pinnacle)
- (31) Qualcomm, Inc. (Qualcomm)
- (32) RF People, Tim Noyes (1)
- (33) RF People, Tim Noyes (2)
- (34) RF People, Davidson Scott (1)
- (35) RF People, Davidson Scott (2)
- (36) RF People, Davidson Scott (3)
- (37) RF People, Davidson Scott (4)
- (38) RF People, Davidson Scott (5)
- (39) RF Safety Solutions, Richard Strickland
- (40) RSI Educational Foundation (RSI) (1)
- (41) RSI (2)
- (42) Dr. Dina Simunic
- (43) Sirius Satellite Radio, Inc. (Sirius)
- (44) Southern Communications Services, Inc. & Southern Company Services, Inc. (Southern)
- (45) Sprint Corporation (Sprint)
- (46) T-Mobile USA, Inc. (T-Mobile)

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- (47) Telecommunications Industry Association (TIA)
- (48) Vocollect, Inc. (Vocollect)
- (49) Wi-Fi Alliance (Wi-Fi)
- (50) Winstar Communications, LLC (Winstar)
- (51) Wireless Communications Association International, Inc. (WCA)
- (52) Holland & Knight LLP
- (53) IBM
- (54) Mobile Computing GBU, IPSP
- (55) University of Rome La Sapienza

REPLY COMMENTS

- (1) Margaret Brown
- (2) Cisco
- (3) Cohen, Dippell and Everist, P.C.
- (4) Dobson Communications Corp. (Dobson)
- (5) The EMR Network
- (6) Hammett and Edison, Inc.
- (7) IT'IS
- (8) Motorola
- (9) palmOne
- (10) PCIA – The Wireless Infrastructure Association (PCIA)
- (11) Qualcomm
- (12) Richard A. Tell
- (13) Southern
- (14) T-Mobile
- (15) WCA

EX PARTE & LATE-FILED COMMENTS

- (1) APREL Laboratories and Spectrum Sciences Institute (APREL)
- (2) Bluetooth SIG, Inc. (Bluetooth SIG)
- (3) CTIA (1)
- (4) CTIA (2)
- (5) CTIA (3)
- (6) CTIA (4)
- (7) Cisco (1)
- (8) Cisco (2)
- (9) Cisco (3)
- (10) Dell
- (11) Food and Drug Administration, Center for Devices and Radiological Health (FDA)
- (12) Angela Flynn
- (13) Hammett and Edison, Inc.
- (14) Hatfield and Dawson
- (15) Hitachi Data Systems (Hitachi)
- (16) Motorola (1)
- (17) Motorola (2)
- (18) National Assoc. of Radio and Telecommunications Engineers, Inc. (NARTE)
- (19) Novatel (1)
- (20) Novatel (2)

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- (21) palmOne
- (22) PCIA – The Wireless Infrastructure Association (PCIA) (2)
- (23) PCIA (2)
- (24) Qualcomm (1)
- (25) Qualcomm (2)
- (26) Qualcomm (3)
- (27) Qualcomm (4)
- (28) Qualcomm (5)
- (29) Qualcomm (6)
- (30) Qualcomm (7)
- (31) Qualcomm (8)
- (32) Qualcomm (9)
- (33) RF People, Tim Noyes (1)
- (34) RF People, Tim Noyes (2)
- (35) RF People, Davidson Scott (1)
- (36) RF People, Davidson Scott (2)
- (37) TCB Council
- (38) TIA
- (39) Towerswitch, LLC (1)
- (40) Towerswitch, LLC (2)
- (41) T-Mobile (1)
- (42) T-Mobile (2)
- (43) XM Radio Inc.

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APPENDIX H

Summary of Comments and discussion on Non-Action Topics from the
2003 Notice of Proposed Rulemaking

1. Localized SAR Summation for Evaluation of Multiple Portable Transmitters

Summary. We requested information on techniques to sum SAR due to multiple transmitters in portable devices. SAR is intended to be the total due to all relevant transmitters, and summation of SAR for multiple transmitters is implicit in our rules. Based on the record and our experience in the equipment authorization program we choose not to modify the rules and instead will continue to provide informative procedural guidance through the OET Laboratory Division Knowledge Database (KDB).

Original Proposals. In the *Notice*, we discussed issues relating to the evaluation of specific absorption rate (SAR) in RF devices with multiple transmitters.¹ We noted that when multiple RF transmitters operate simultaneously in a device, they typically use different frequencies and that evaluation of compliance for each device is dependent on the specific transmitter frequencies involved. We stated that a convenient way to evaluate the SAR of a single device with multiple transmitters using present measurement systems is to add together the SAR values individually obtained for each transmitter in order to estimate the total SAR for a given device. At the same time, we recognized that this procedure would generally overestimate true RF exposure levels from such devices. Nonetheless, in the absence of any specific procedure developed by expert organizations, we proposed to specify that the maximum RF exposure levels of all transmitters and associated antennas within a single portable device that could functionally transmit at the same time be added together in order to determine RF exposure values for the device. However, we also requested comment on whether it would be appropriate and practical with present SAR measurement systems to sum the SAR values at individual evaluation grid points prior to computing the 1-g average SAR, as opposed to simply summing the 1-g averaged SAR values of each transmitter. Different results could be obtained depending on which method is used.

Comments. Many commenters who addressed this issue are in agreement that adding individual SAR values for each transmitter should be allowed as an option for evaluating total exposure,² even though such a procedure is likely to overestimate actual SAR in many cases. Other commenters found this procedure to be unacceptable or noted that alternative methodologies are being developed.³ CTIA and others urged the Commission also to allow an option whereby SAR distributions – rather than maximum SAR values – from different transmitters are added, such as a method provided in a then-draft standard being developed by IEC TC106, PT 62209.⁴ APREL further urged the Commission to accept alternative methodologies in future rule-makings, such as the one included in IEC standard 62209-1, since these techniques were still under development.⁵ Nokia agreed that adding SAR values together, as proposed, should be allowed where more accurate methodologies are not available, since this procedure will consistently provide a conservative total SAR. However, rather than the alternative “grid point” approach mentioned in the *Notice*, which Nokia claimed would needlessly require time and resources from SAR

¹ See *Notice of Proposed Rule Making*, ET Docket 03-137, *Proposed Changes in the Commission’s Rules Regarding Human Exposure to Radio frequency Electromagnetic Fields*, 18 FCC Rcd 13187 (2003) at para. 31.

² See CTIA comments at 10-11; IEEE 802 comments at 7; Motorola comments at 8-9; Nokia comments at 6-7; PalmOne reply comments at 4; T-Mobile comments at 16; TIA comments at 10; Vocollect comments at 6-7; Wi-Fi comments at 9.

³ See APREL reply comments at 4; Cisco comments at 11-12; Dell comments at 3; Ericsson comments at 6-7.

⁴ See CTIA comments at 10-11; Dave Fry comments at 1; Ericsson comments at 6-7; ITI comments at 7-8; Motorola comments at 8-9.

⁵ See APREL reply comments at 4.

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measurement system manufacturers, Nokia suggested the alternative of performing individual SAR tests on all transmitters and basing total SAR evaluation on the addition of area scan distributions.⁶ The TIA advocated a similar approach as providing greater accuracy.⁷

According to Vocollect, Inc. (Vocollect), the two approaches discussed in the *Notice*: simple 1-g SAR summation or a grid point approach, should usually give similar results.⁸ However, Vocollect maintained that when one transmitter in a given device uses significantly higher power than other transmitters in the same device, only the higher-powered transmitter should be evaluated, since the contributions of the others would be negligible. Vocollect suggested that the Commission not require SAR testing of transmitters whose combined power is less than 10% of the most powerful transmitter in the device.

Cisco noted that unless antennas within a host device are co-located or located within a distance of two to three times the dimension of the largest antenna, the body does not absorb RF energy in the same location, and the multiple devices thus do not compound the SAR at any location on or in the body. Cisco suggested that, in such situations, testing for compliance with the SAR rules should be required only for antennas of differing physical characteristics; *i.e.*, there is no need to test two or more identical antennas. Cisco also proposed that the Commission require, when necessary, SAR evaluation only for those channels that radiate “maximum power.”⁹

Discussion. We agree with commenters that there may be multiple valid ways to determine SAR from co-located transmitters operating simultaneously.¹⁰ SAR as defined in the literature is clearly the total SAR due to all relevant transmitters and summation of SAR for multiple transmitters is implicit in our rules.¹¹ In view of the technical comments provided, where we have not taken action already, the KDB guidance will continue to be revised to further clarify SAR summation techniques based upon 1-gram-averages. Other accepted procedures will be incorporated into the KDB once the feasibility and reliability of such procedures are established and measurement methodologies are developed. These procedures potentially include each and all of the alternatives proposed by commenters outlined above and methods presently being considered by standards-developing organizations such as International Electrotechnical Commission Technical Committee 106. Acceptable alternatives have been specified in updated versions

⁶ See Nokia comments at 6-7.

⁷ See TIA comments at 10.

⁸ See Vocollect comments at 6-7.

⁹ See Cisco comments at 11-12.

¹⁰ Exposures due to multiple transmitters are considered “simultaneous” if these exposures occur in the same time averaging period. For example, for two variable power consumer transmitters averaged over the same source-based time averaging period, the exposure based on the time-averaged SARs must be summed even though either transmitter may not necessarily be transmitting at the same instant. In principle, time averaging periods up to 30 minutes could be required; however, shorter time averaging periods less than 30 minutes are permitted, and in fact are required for mobile and portable consumer devices, to avoid redundant or repetitive measurements, provided that measurements performed using a shorter time averaging period result in the maximum aggregate time-averaged SAR of the multiple transmitters being summed (*i.e.*, accounting for maximum duty cycle, maximum transmitted power, overlapping transmission, etc.). Alternatively, short time averaging periods (*e.g.*, over one pulse at maximum power) may be selected to conservatively measure SAR and avoid the need to sum SARs from multiple transmitters during non-overlapping transmission.

¹¹ See 47 CFR § 2.1093(d).

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of OET Laboratory Division publications, including procedures to identify co-located simultaneous transmission conditions for SAR evaluation and test reduction or exclusion.¹²

2. Modular Transmitters Installed in Various End-Use Products

Summary. In the *Notice*, we proposed grouping of transmitter modules as used in various devices into three classes (cell phones, laptops, and PDAs), intended to reflect different exposure conditions and spatial relationships of transmitters to different parts of the body. However, these classifications have been overtaken by the ongoing evolution of communications products that have a wide variety of designs and capabilities. OET Laboratory guidance and intervening rule changes have addressed exposure issues particular to modules. Also, our general exemption proposals in the *Further Notice* apply equally to modules and other transmitters that may be installed in a single device making specific rules for modular exemption unnecessary.

Background. Transmitter modules are designed for installation in a variety of products, either by product manufacturers, OEM integrators, or as after-market accessories installed by users. Many of these licensed and unlicensed modules or module-like transmitters can be either permanently installed internally in host devices such as laptop computers by system integrators or temporarily installed externally as plug-in cards or USB dongles. Key RF exposure issues for modules include: (1) the fact that the host mechanical environment and installed separation distance from the body, which both affect SAR, may not be known on approval; and (2) modules are often operated at the same time as other transmitters within the host, which can change the overall SAR distribution or exceed the exposure limit.

Modular device technology and modular RF exposure policy and procedures have both progressed significantly since issuance of the *Notice*. Since the *Notice*, a rule making creating section 15.212 has defined general requirements for modular transmitters¹³ and the Laboratory has published and implemented streamlined test reduction and evaluation procedures in response to requests for more detailed guidelines to appropriately manage the number of SAR measurements that are required for complex multiple transmitter configurations and to allow TCB approval of most devices.¹⁴ Section 15.212(a)(1)(viii) requires that modular transmitters must comply with any applicable RF exposure requirements in their final configuration and section 15.212(b) provides for limited modular approval “where compliance with RF exposure rules is demonstrated only for particular product configurations.” Limited modular approval requires the applicant to state how it will ensure compliance of the end product. In the past, we have categorically excluded the majority of Part 15 devices from routine RF evaluation (except for Unlicensed Personal Communications Service, Unlicensed National Information Infrastructure, and millimeter wave devices); however, for section 15.247 modular transmitters using IEEE 802.11, we have required RF evaluation on a case-by-case basis due to power and proximity to the body as 802.11 products and technologies continue to evolve.¹⁵ While we include this section on modular transmitters to support a complete discussion of the record, we will not take further action with respect to modular transmitters at this time.

¹² Recent procedures provided by the FCC Laboratory have already taken into consideration both the 1-g and grid-point summing methods. Since the grid-point summing method has measurement constraints and is very time-consuming, the Laboratory has also provided additional test reduction criteria in different test procedures to streamline SAR simultaneous transmission requirements.

¹³ After release of the *Notice*, the Commission codified procedures in § 15.212 in Public Notice DA 00-1407, 15 FCC Rcd 25,415 (2000).

¹⁴ See documents at the FCC Equipment Authorization website at: <http://www.fcc.gov/oet/ea/>.

¹⁵ In accordance with §1.1307(c) and (d) of our rules (47 CFR § 1.1307(c), (d)).

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Original Proposals. In the *Notice*, we made several proposals and requested comment and information regarding rules and guidelines for approval of modular transmitters for ensuring compliance with our RF exposure limits. In particular, manufacturers desired a protocol under which a module may be approved on a “host-independent” basis so that it can be used in different hosts without subjecting the host devices to new or additional RF exposure evaluation. Moreover, general or generic host-independence is the defining characteristic of an unlimited modular transmitter approval. We proposed general requirements in order to establish host-independence for any type of host for a given module; such modules are referred to as generic modules. We asked for comment on whether the standard power threshold (100 mW peak) would be suitable for generic modules. We sought comment on whether we should require measurements in certain typical host device configurations or whether we should permit physically similar configurations under our permissive change rules, and if a permissive change would be allowed, whether it should be Class I or II.¹⁶

We recognized in the *Notice* that specific categories of hosts have different operating characteristics that could influence the RF exposure potential of an installed module. Accordingly, we proposed to adopt distinct RF exclusion and evaluation criteria for section 15.247 modules that would only be installed in one of three specific categories of hosts. These categories were: (1) radiotelephones, (2) laptop (notebook) computers and (3) personal digital assistants (PDAs). For radiotelephones, pagers, and other devices that are used in close proximity to the head or body, we proposed that we would not require SAR evaluation subsequent to the addition of any modular transmitter that operates at or below 2 mW (peak radiated or conducted output power). For transmitting modules that are added to the keyboard section of a laptop computer, we proposed that any modular RF transmitter need not undergo RF exposure analysis if it operates at less than 10 mW (peak radiated power). For transmitting modules where the radiating element is to be mounted in the screen portion of a laptop, we proposed that when the radiating element will be more than 20 cm from the user’s body, we would permit a power level up to 200 mW without requiring an RF evaluation. We proposed that for transmitter modules designed to be incorporated into a handheld PDA, we would use a threshold value of 25 mW for exclusion from routine SAR evaluation for a PDA that is used exclusively as a handheld device. For PDAs that can be used in contact with the head or worn against the body, we proposed to use the same 2 mW threshold for additional transmitting modules that we proposed for modules used in mobile phones.

Comments. Generic Modules: Ericsson, Motorola, and the Information Technology Industry Council (ITI) were generally supportive of the 100 mW exclusion threshold of generic modules in certain configurations and exposure conditions.¹⁷ Cisco claimed the 100 mW exclusion threshold is overly restrictive and FDA requested an explanation for a basis and were critical of the exclusion threshold of generic modules.¹⁸ Vocollect offered data in support of a 125 mW threshold instead of the proposed exclusion threshold power. APREL, IT’IS, and Dr. Dina Simunic provided SAR calculations and data to argue that the proposed exclusion threshold would exceed our SAR limit in certain situations.¹⁹ Motorola, CTIA, PalmOne, Ericsson IEEE 802, Wi-Fi, and others generally supported use of the permissive change rules as a basis to allow the use of previously authorized modules in new host devices,²⁰ accounting for measurement uncertainty,²¹ and supported conditioning an initial grant to configurations

¹⁶ See 47 CFR § 2.1043 for description of permissive changes.

¹⁷ See Ericsson comments at 4; Motorola comments at 5-8; CTIA comments at 8-9; ITI comments at 7.

¹⁸ See Cisco comments at 9-10; FDA comments at 1.

¹⁹ See APREL comments at 4; IT’IS reply comments at 1; Dr. Simunic comments at 2.

²⁰ See PalmOne comments at 2; Ericsson comments at 5; IEEE 802 comments at 6; Wi-Fi comments at 7; Motorola comments at 6; CTIA comments at 9; Vocollect comments at 8.

²¹ See Motorola comments at 7; CTIA comments at 10; PalmOne comments at 2; PalmOne reply comments at 2.

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where the host device is physically similar.²² TIA and Ericsson recommended that if such modules cannot be used simultaneously there should be no limit on the number of transmitters than can be added without re-evaluation. Qualcomm, Dell, Inc. (Dell), HP, Novatel Wireless, Inc. (Novatel), and PalmOne asked that considerations for modules apply to both licensed and unlicensed devices.²³ Hitachi Data Systems (Hitachi) and Novatel endorsed in part Qualcomm's proposal to provide for an expedited and streamlined approach to licensed modular approvals.²⁴

Radiotelephones: Many commenters thought that the proposed 2 mW threshold for modules added to radiotelephones is too conservative.²⁵ Others suggested various alternative values above the proposed threshold.²⁶ ITI believed that having a variety of exclusion thresholds based on the type of device will create confusion for Test Certification Bodies (TCBs), as well as for manufacturers.²⁷ PalmOne maintained that the Commission must be clear on how to handle the following two scenarios: (1) the new SAR value increases less than the level of uncertainty but exceeds the allowed SAR limit; and (2) the initial SAR measurement is scaled up, and the scaled value exceeds the allowable SAR limit, while the measured result is below the limit.²⁸

Laptop (Notebook) Computers: Many commenters suggested that the 10 mW threshold for modules added to laptops may be overly conservative, proffering instead a higher threshold than that proposed in the Notice.²⁹ IEEE 802 proposed to allow multiple modules in a laptop keyboard section when the aggregate power of such modules is less than 10 mW.³⁰ Nokia said it agreed with the proposed exclusion thresholds for modules in laptop computers³¹ but noted that the proposed new rules make no reference to laptops that have not previously been evaluated for RF exposure, *i.e.*, laptops without built-in transmitters. PalmOne noted that it is the location of the transmitting antenna, rather than the type of module, that determines the SAR value and, therefore, should be the major consideration.³² Nokia supported the 200 mW exclusion for laptop display screen modules.³³

Personal Digital Assistants (PDAs) and Similar Handheld Devices: Nokia and Ericsson believed that the proposed 25 mW exclusion threshold for hand-only exposure is too conservative.³⁴ ITI requested that the Commission allow a higher power threshold for PDAs using lower gain antennas and consider PDAs as

²² See also Dell comments at 2; Ericsson comments at 5-6; TIA comments at 8-9.

²³ See Qualcomm comments at i-ii, 1-4, 9; Dell *ex parte* at 1; HP comments at 1; Novatel comments at 1; PalmOne comments at 4.

²⁴ See Hitachi comments at 1; Novatel reply comments at 1.

²⁵ See Ericsson comments at 5-6; Motorola comments at 8.

²⁶ See Bluetooth SIG comments at 3-4; Motorola comments at 8 and Appendix C; Nokia comments at 3-6.

²⁷ See ITIC comments at 5-7.

²⁸ See PalmOne reply comments at 2-3.

²⁹ See Dell comments at 2-3; Ericsson comments at 5-6; ITI comments at 6; Qualcomm comments at 8-9, *ex parte* at 1-4; Dell comments at 2-3; HP comments at 1; IEEE 802 comments at 7.

³⁰ See IEEE 802 comments at 7.

³¹ See Nokia comments at 5.

³² See PalmOne comments at 3.

³³ See Nokia comments at 5.

³⁴ See Nokia comments at 5-6; Ericsson comments at 5-6.

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handheld computers.³⁵ For hand-only exposure, Dell suggested using 100 mW instead of the 25 mW threshold proposed in the *Notice*.³⁶ Dell and PalmOne noted that it is difficult to determine when a PDA device would be used exclusively as a handheld device or as a handheld and body-worn device.³⁷

Discussion. With respect to inclusion of licensed modules in the scope of this proceeding, while the context of the *Notice* was Part 15 unlicensed modules, the exposure considerations were general and apply equally to licensed modules. While the Commission introduced the three host categories in the *Notice*, as products and technologies have continued to advance we have moved away from the concept of device categories and instead have developed generic policies that are more relevant to today's products and technologies – multiple licensed and unlicensed transmitters capable of simultaneous transmission in varying hosts. In the course of this proceeding, the specific three categories of hosts and associated exclusion powers proposed in the *Notice* have been overtaken with the general power exemption thresholds proposed in the *Further Notice* below in this proceeding and dealing with these types of hosts individually in the rules is unnecessary. Aside from power exclusion, the remaining issues specific to modular transmitters are primarily procedural and administrative; for example, the FCC Laboratory can handle permissive changes, OEM integration, and user operating/installation issues within the broad scope of the current rules.

3. Spatial Averaging for Fixed Transmitters as a Valid Approach to be Considered in a Future Revision of OET Bulletin 65

Summary. We requested information on techniques and the fundamental validity of spatial averaging as an approach to evaluating compliance with field intensity limits at fixed transmitter sites. Spatial averaging is not codified in our rules and we did not propose any changes to our rules in the *Notice*. However, the concept of spatial averaging is described briefly in OET Bulletin 65. After full consideration, we are not adopting specific guidelines in our rules with respect to spatial averaging at this time. However, we intend to update OET Bulletin 65 based on the information received with consideration of SAR as a primary compliance metric.

Original Proposal. Compliance with the Commission's MPE limits for fixed antennas is based on the concept of averaging power density or field strength squared over a prescribed area, as recommended in IEEE and NCRP standards and publications.³⁸ There can be situations where a highly localized ("spatial peak") field intensity exceeds our MPE limits near an antenna where public or worker access is possible, while a spatially-averaged measurement over a larger area indicates compliance. It is possible that such localized "hot spots" could lead to SAR values in the body of a nearby person that exceed the partial-body value for SAR adopted by the Commission while not exceeding the whole-body limit. This can be relevant for exposures from both fixed antennas and antennas associated with mobile devices since our rules also allow evaluation of exposure in terms of field strength or power density. Accordingly, we asked for comment on whether spatial averaging is appropriate in these circumstances.

In the *Notice*, we did not make any specific proposals regarding spatial averaging, rather we asked for comment on the best way to ensure compliance in these situations, other than requiring burdensome SAR evaluations for localized and/or whole-body SAR, which could be impractical and costly. We requested comment on the issue of when spatial averaging of exposure is appropriate and how to deal with localized exposure in situations where spatial peak measurements may exceed the MPE limit values.

³⁵ See ITI comments at 7.

³⁶ See Dell comments at 3.

³⁷ See Dell comments at 3; PalmOne comments at 4-5.

³⁸ See IEEE Std. C95.3-2002, Section 4.2.1.2; NCRP Report No. 119, Section 3.3.5.

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We also asked for comment on procedures for averaging spatially over the whole body. Current procedures involve averaging readings made in specific locations representing the position of the whole body of a potentially exposed person. Slightly different procedures have been suggested for situations in which single emitters are present and those in which multiple emitters are present and no single RF source predominates. We asked for comment on this approach, including whether using the maximum of several readings taken with the measurement probe in different orientations would be more appropriate. We asked whether the Commission should adopt or recommend a specific technique or procedure for whole-body spatial averaging to determine compliance with the exposure limits and, if so, what technique or procedure we should adopt. We suggested that such guidance could be issued in the form of a Public Notice or could be incorporated into a new edition of OET Bulletin 65.

Comments. Many commenters agreed that spatial averaging of RF exposure is not appropriate in close proximity to RF sources. They provided a variety of recommendations regarding, first, when spatial averaging should be invoked or required and, second, how it should be performed when appropriate. On the primary issue of whether spatial averaging is adequate to ensure compliance with the partial-body SAR limits, there appears to be agreement that whole body spatial averages are not appropriate in all circumstances, particularly those involving partial body exposure close to transmitting antennas.

Pinnacle Telecom Group (Pinnacle) supported the position that spatially-averaged measurements are not appropriate in areas very close to antennas (such as on a rooftop), because exposure is not truly “whole-body.”³⁹ Pinnacle believes that this issue is best addressed in a future revision of OET Bulletin 65. Pinnacle noted that farther away from such antennas, where the exposure may be closer to whole-body, spatial peak measurements may overstate whole-body exposure, but peak measurements are still typically low enough to demonstrate compliance. Therefore, Pinnacle suggested simply requiring spatial peak measurements in a rooftop environment. It said that this method is easy to apply in practice and is consistent with a conservative approach to RF safety. RF People made a similar suggestion for considering use of spatial peak readings.⁴⁰ In addition, RF People suggested that, in situations where whole-body averaging may not be appropriate, averaging could be carried out over smaller regions of the projected area of the whole-body, with the maximum of these averages used for demonstrating compliance.

Richard Strickland of RF Safety Solutions (Strickland) said that a serious misuse of spatial averaging occurs when an individual is exposed to a very strong RF field over only part of his or her body when in close proximity to an antenna.⁴¹ An example of this is when a tower climber is located on the tower with his or her head in the aperture of a high-power broadcast antenna. Strickland noted that a similar situation can occur near the panels of sector antennas used for wireless telecommunications, although the field levels from these systems would be expected to be much lower. On the other hand, Strickland pointed out, for microwave sources having very high power levels, the risk to the eyes may be greater. Strickland maintained that, when appropriate, spatial averaging can significantly reduce the level of measurement uncertainty and that spatially-averaged measurements will be significantly less variable and more meaningful than spatial peak measurements.

Cisco agreed that there can be situations where spatially-averaged measurements may indicate compliance while localized exposures could lead to SAR values that exceed partial-body limits (but not whole-body limits).⁴² Under these circumstances, Cisco believed that the best way to ensure compliance

³⁹ See Pinnacle comments at 7-8.

⁴⁰ See RF People reply comments at 1-2.

⁴¹ See Richard Strickland (RF Safety Solutions) comments at 1-3.

⁴² See Cisco comments at 12.

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is by use of computational modeling supported by adequate documentation. It pointed to a study by Professor Om Gandhi that illustrates how this technique can be used to evaluate compliance.⁴³

The IT'IS Foundation stated that its evaluations of plane-wave conditions indicated that current MPE limits are inconsistent with spatial peak SAR limits.⁴⁴ Therefore, IT'IS maintained that spatial averaging is not advisable. Until more data are available, IT'IS recommended the use of "non-averaged spatial peak SAR values" for demonstrating compliance with spatial peak SAR values. It also noted that compliance can only be reliably demonstrated in the near field of a transmitter if both incident electric and magnetic fields are measured and compared with MPE limits. The FDA commented that it is important to ensure that the partial-body limit not be exceeded and it urged the Commission to provide more information on how to ensure compliance.⁴⁵ T-Mobile USA, Inc. (T-Mobile) supported consideration of both spatial and time averaging to determine compliance with MPE limits, but only for occupational/controlled exposure situations.⁴⁶

Hammett and Edison, Inc. (Hammett and Edison) believed that spatial averaging does not have to be part of a typical compliance survey.⁴⁷ It maintained that for many situations spatial peak measurements are sufficient to determine compliance, since the spatial average cannot exceed the spatial peak. Therefore, Hammett and Edison recommended that the Commission not require spatial averaging in circumstances where compliance can be demonstrated using spatial peak measurements.

With respect to the secondary issue regarding how spatial averaging should be performed when appropriate, there were comments on technique, uncertainty and repeatability, and more general measurement issues. Hammett and Edison noted that a variety of procedures may be used but submitted that there is no guidance as to which is best. It stated that results using various techniques can differ by more than 1 dB, and it maintains that use of the vertical line method, mentioned in the *Notice*, is not a whole-body average.⁴⁸ Hammett and Edison recommended that the Commission adopt the technique described by the Canadian government's Safety Code 6, which specifies spatial averaging over a planar region at the torso level, while also allowing use of alternative techniques, including the current vertical-line method for "non-critical" surveys. To ensure a conservative result, Hammett and Edison recommended that spatial peak measurements be made while varying the orientation of the operator and instrument probe, with the center of the probe held at a fixed location, in order to determine the orientation that results in the highest reading. It continued that the spatial average should then be made in this orientation from 20 cm above ground to a height no greater than 2 meters. To prevent perturbation of the probe due to the ground, Hammett and Edison suggested that it is not appropriate to make measurements within 20 cm of the ground.

Strickland pointed out that fields at complex sites can vary dramatically over small distances in any direction. He noted that it is often necessary to perform at least five spatially-averaged measurements in the same location to be confident of a reasonably accurate evaluation. He suggested that if an initial evaluation in one position indicates that field levels are close to the MPE limits, four to five spatially-averaged measurements should be made with the operator standing in one position and then repeated in a

⁴³ See Cisco comments at 12 and Appendix A.

⁴⁴ See IT'IS comments at 3.

⁴⁵ See FDA comments at 1.

⁴⁶ See T-Mobile comments at 16.

⁴⁷ See Hammett and Edison comments at 4-5.

⁴⁸ *Id.*

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minimum of four different positions. He believed that if the results are within 10 percent of the mean value, then the evaluation is reasonably accurate.

Richard A. Tell (Tell) also stressed the need for multiple measures of spatial averages in the field, especially when strong VHF fields are being measured and when they are vertically polarized.⁴⁹ He submitted results of studies showing that measures of spatially-averaged fields can vary by as much as a factor of five, depending on orientation of the observer. Tell believed that the mean value of multiple spatial averages is a better estimator of an unperturbed field than any single measurement. He suggested a series of spatially averaged measurements be performed using four to eight different orientations, or alternatively, at least four measurements, spaced 90 degrees apart, may be sufficient. But, he noted, when the overall average is close to the actual MPE limit, it becomes more important to use a greater number of measurements to obtain the mean value. Tell recommended that the repeatability of measurements be documented for compliance purposes. This can be accomplished, he suggested, by performing repeated measurements at a specific location and calculating the standard deviation, expressing the result as percentage of the overall mean value.

Tell reported his observation that it is not reasonable to expect better than about 8% repeatability in making a spatially-averaged measurement and that variability in measurement results increases with the complexity of a site.⁵⁰ For this reason Tell recommended a simple, straight, vertical line method for performing a spatial average as the method that will generally be the least susceptible to variation over repeated measurements. He suggested that vertical line spatial averages be determined from near ground to a height of six feet.

Several commenters referred us to IEEE Standard C95.3-2002 for guidance on these issues.⁵¹ Motorola contended that if there are areas where this standard is unclear or requires interpretation, the Commission should bring this to the attention of the IEEE before adopting its own specific techniques or procedures through rule-making. The C95.3 standard deals mainly with the secondary issue of how spatial averaging should be defined and performed when appropriate. It does not address in detail the primary issue of the appropriateness and limitations of spatial averaging with respect to localized SAR compliance.

Discussion. Spatial averaging is an evaluation issue and as such is not covered in our rules; it is generally described in OET Bulletin 65 and we do not intend to change this approach. Nonetheless, the comments we received are very helpful. They have been discussed here to illuminate our considerations as we develop recommendations in a revised version of OET Bulletin 65. We may also develop a supplement to OET Bulletin 65 to provide guidelines on appropriate field measurement techniques to use when evaluating exposure in terms of field strength and/or power density. This approach will provide greater flexibility with respect to future modifications to procedures that may be recommended over time by expert standards organizations, and we wish to maintain flexibility in our ability to promptly implement such modifications.

We plan to provide guidance in OET Bulletin 65 that will ensure safety and also provide for repeatability of measurements to the greatest extent possible. Until more specific guidance is given in OET Bulletin 65, we caution that at locations close to antennas where spatial averaging may not be appropriate (because the localized SAR limit may be exceeded), the spatial peak field should be used to determine compliance. The peak value will always be greater than or equal to the average and thus conservative for determining

⁴⁹ See Richard Tell reply comments at 2-5.

⁵⁰ See Richard Tell reply comments at 5-7.

⁵¹ See Ericsson comments at 8; Hatfield and Dawson comments at 1; IEEE 802 comments at 8; Motorola comments at 15; Nokia comments at 8; Wi-Fi comments at 10.

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compliance. The Commission will continue the practice for routine enforcement activities near fixed RF sources of performing linear spatial averages at frequencies less than 6 GHz and using spatial peak power density at frequencies above 6 GHz. If it becomes clear in specific cases that the local SAR may exceed limits, the Commission may require the use of spatial peak field measurements.

Revisions to OET Bulletin 65 will specifically address measurement uncertainty and repeatability. For example, the suggestion offered by Richard Tell for reporting the standard deviation of a measurement survey has merit and we will consider it in developing our revision. We also herein indicate and intend to reiterate in a future revision of OET Bulletin 65 that parties making measurements have the option of performing spatial peak measurements in lieu of spatial averages in any circumstance, since compliance with peak measurements will always be more conservative than compliance with average values. The comments of Hammett and Edison, Strickland, and others regarding the various techniques available for spatial averaging are informative and will be used in recommending procedures that will be technically supportable and will reduce measurement uncertainty to the greatest degree possible consistent with current knowledge of these matters.

The IEEE Standard C95.3-2002, which some commenters support, does not provide sufficient information on the rationale for spatial averaging to resolve the primary issue of SAR compliance we raised in the *Notice*. For example, whole-body spatial averaging over an area significantly larger than the whole body of some persons including children may not ensure SAR compliance in all situations. However, as suggested by Motorola, we will consider requesting interpretations or clarifications from the IEEE as necessary, including additional guidance from the IEEE with respect to averaging under partial-body exposure conditions. We are aware of and will consider the more recent IEEE Standard C95.1-2005, which addresses some of the limitations of spatial averaging, defining frequency-dependent spatial averaging areas and explicit spatial peak field limits. We will also consider the recent activity pertaining to spatial averaging in the deliberations of IEC's wireless base station evaluation project 62232⁵² and recent research on the validity of spatial averaging with respect to SAR compliance.⁵³

4. Local Zoning Concerns

Summary. Although not specifically raised in the *Notice*, commenters addressed the issue of the extent that preemption permits state and local governments to require additional technical showings demonstrating compliance with our exposure limits that go beyond those outlined in the *Local Official's Guide*. We reiterate our policy that certain requests by state or local governments for additional technical showings or other similar requirements may be unnecessarily burdensome on personal wireless service providers.

In the course of this proceeding, several parties have commented that local jurisdictions, apparently unaware of the extent of Federal Government preemption in the area of RF safety, have promulgated ordinances or zoning regulations that require local personal wireless service providers to provide detailed technical showings of their compliance with our exposure limits (without regard to our criteria for categorically excluding sites where there is no reason to believe an exposure issue exists) or to have their cell sites evaluated by an outside party at the company's expense.⁵⁴ In many cases, they alleged, such

⁵² International Electrotechnical Commission, Technical Committee 106, Project 62232.

⁵³ See Findlay, R. P. and Dimbylow, P. J., *Spatial Averaging of Fields from Half-Wave Dipole Antennas and Corresponding SAR Calculations in the NORMAN Human Voxel Model Between 65 MHz and 2 GHz*, Physics in Medicine and Biology, 54 2437-2447, 2009. See also Findlay, R. P. and Dimbylow, P. J., *Calculated SAR distributions in a human voxel phantom due to the reflection of electromagnetic fields from a ground plane between 65 MHz and 2 GHz*, Physics in Medicine and Biology, 53 2277-2289, 2009.

⁵⁴ See T-Mobile *ex parte* (dated Nov. 18, 2004) at 2, 4, 6-7, 11-16 and 19; T-Mobile Supplemental *ex parte* (dated Dec. 10, 2004) at 1-3; T-Mobile Second Supplemental *ex parte* (dated Dec. 23, 2005) at 1, 6-10, 21 and 24 ; CTIA (continued....)

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evaluations are required on a recurring basis.⁵⁵ These parties requested that the Commission clarify and reaffirm that the Commission has exclusive authority in determining whether personal wireless service transmitters are compliant with its RF exposure rules and that local governments with concerns about licensee compliance must raise those matters with the Commission.⁵⁶

Discussion. Section 332(c)(7)(B)(iv) of the Communications Act provides that “[n]o State or local government or instrumentality thereof may regulate the placement, construction, and modification of personal wireless service facilities on the basis of the environmental effects of radiofrequency emissions to the extent that such facilities comply with the Commission’s regulations concerning such emissions.”⁵⁷ Pursuant to section 332(c)(7) of the Communications Act and consistent with the Commission’s general authority to regulate the operation of radio facilities,⁵⁸ the Commission, in the *RF Procedures Report and Order* in WT Docket No. 97-192, found that state and local governments are “broadly preempted from regulating the operation of personal wireless service facilities based on RF emission considerations.”⁵⁹ A local government, for example, “may not require a facility to comply with RF emissions or exposure limits that are stricter than those set forth in the Commission’s rules and it may not restrict how a facility authorized by the Commission may operate based on RF emissions or any other cause.”⁶⁰ State or local authority with respect to personal wireless service facilities is limited to regulation of the placement, construction, and modification of such facilities.⁶¹

In the *RF Procedures Report and Order*, the Commission also considered the extent to which state and local governments are permitted to request that wireless service providers demonstrate compliance with the Commission’s RF exposure guidelines.⁶² The Commission recognized the need to balance the state and local governments’ “legitimate interest in ascertaining that facilities will comply with the RF exposure limits set forth in [the Commission’s] rules” and the carriers’ concerns that “certain requirements related to demonstrating compliance can be unnecessarily burdensome.”⁶³ The Commission decided that a binding rule governing demonstrations of compliance was not necessary.⁶⁴ The

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ex parte (dated Jan. 11, 2005) at 1; CTIA Supplemental *ex parte* (dated Jan. 28, 2005,) at 1-4, 11, 13, 20, 25, 27-32, 34-37, 42 and 44; PCIA reply comments at 2, 9, 12 and 15-16; PCIA *ex parte* (dated Nov. 18, 2004) at 1.

⁵⁵ See T-Mobile *ex parte* (dated Nov. 18, 2004) at 13 and 16; T-Mobile Second Supplemental *ex parte* (dated Dec. 23, 2005) at 1 and 9-10; CTIA Supplemental *ex parte* (dated Jan. 28, 2005) at 4, 28-29, 34 and 36; PCIA reply comments at 4, 9 and 15.

⁵⁶ See T-Mobile *ex parte* (dated Nov. 18, 2004) at 2; T-Mobile Supplemental *ex parte* (dated Dec. 10, 2004) at 1-2; T-Mobile Second Supplemental *ex parte* (dated Dec. 23, 2005) at 1-2; CTIA *ex parte* (dated Jan. 11, 2005) at 1-2; CTIA Supplemental *ex parte* (dated Jan. 28, 2005) at 1-3; PCIA reply comments at 4.

⁵⁷ 47 U.S.C. § 332(c)(7)(B)(iv).

⁵⁸ 47 U.S.C. § 301.

⁵⁹ *Procedures for Reviewing Requests for Relief From State and Local Regulations Pursuant to Section 332(c)(7)(B)(v) of the Communications Act of 1934, Report and Order*, 15 FCC Rcd 22821 (2000) (“*RF Procedures Report and Order*”). The Commission’s plenary authority in this area has been upheld by the courts. See *Cellular Phone Taskforce v. FCC*, 205 F.3d 82, 95-96 (2d Cir. 2000), *cert. denied*, 531 U.S. 1070 (2001). But *cf.* *Sprint Spectrum*, 283 F.3d 404, 415-422 (2d Cir. 2002) (preemption does not apply to non-regulatory decisions of a local governmental entity).

⁶⁰ *Id.* at 8.

⁶¹ *Id.* at 8.

⁶² *Id.* at 8-9.

⁶³ *Id.* at 8.

⁶⁴ *Id.* at 9.

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Commission expected that the nonbinding *Local Official's Guide*, released jointly with the Local and State Government Advisory Committee (LSGAC),⁶⁵ would facilitate the resolution of many disputes regarding demonstrations of compliance with its RF emissions rules, without resorting to litigation or other formal dispute resolution and in a manner that would allow personal wireless services to be deployed and delivered to consumers as rapidly as possible, while preserving the authority of state and local jurisdictions in land use matters and in protecting the public health.⁶⁶

The principles set forth in the *Local Official's Guide* provide a framework for local and state governments and wireless service providers to work cooperatively on this issue.⁶⁷ In particular, these principles provide guidance to local governments attempting to determine if a radio transmission facility might raise compliance concerns by helping local governments readily recognize sites that do not raise RF exposure compliance concerns (e.g., through the use of effective radiated power and separation distance tables and a checklist to determine categorical exclusions), as well as information for initiating a Commission inquiry in instances where a facilities operator is unable to dispel a local government's concerns about compliance. We note, however, that any substantive determination of compliance with the RF exposure rules remains within the exclusive purview of the Commission.⁶⁸

Where there is a genuine question regarding a site's compliance with the RF exposure limits, e.g., when a site cannot be determined to be compliant using the criteria found in the *Local Official's Guide*, the Commission indicated that its staff would promptly take all appropriate actions to ensure compliance. In particular, "if a local government were to make a Commission inquiry regarding a site's compliance with RF exposure limits in a case where compliance cannot be readily demonstrated by applying the principles set forth in the *Local Official's Guide*, [the Commission] would require the operator of the facility to provide sufficient information to demonstrate compliance."⁶⁹ The Commission also indicated that it would consider whether a particular requirement to demonstrate compliance violates section 332(c)(7) in a properly filed case.⁷⁰

⁶⁵ The LSGAC was a body of elected and appointed local, state, and tribal government officials appointed by the Chairman of the Commission. It provided advice and information to the Commission on key issues that concern local and state governments and communicated state and local government policy concerns regarding proposed Commission actions. We note that the LSGAC is now the Intergovernmental Advisory Committee (IAC). See *Modification of Subpart G, Section 0.701 of the Commission's Rules*, Order, FCC 03-180 (2003).

⁶⁶ *A Local Government Official's Guide to Transmitting Antenna RF Emission Safety: Rules, Procedures, and Practical Guidance* (June 2, 2000) ("*Local Official's Guide*").

⁶⁷ The *Local Official's Guide* provides information and voluntary guidance to local governments to facilitate their ability to devise reasonable and effective procedures for assuring that antenna facilities located within their boundaries comply with Commission limits for human exposure to RF emissions. It provides, among other things, a summary of the RF exposure guidelines and the Commission's procedures for ensuring licensee compliance and enforcing its rules, including brief descriptions of various licensing requirements by type of service. See *RF Procedures Report and Order* at 8.

⁶⁸ See 47 U.S.C. § 332(c)(7)(B)(iv); *Cellular Phone Taskforce*, 205 F. 3d at 95-96; *RF Procedures Report and Order* at 8; see also 5 U.S.C. §§ 502 (forfeiture provisions for violations of Commission rules and regulations).

⁶⁹ *RF Procedures Report and Order* at 9. The provision of such information is consistent with the operator's affirmative obligation to confirm compliance for all facilities that are not excluded. See 47 C.F.R. § 1.1307(b). In addition, we note that an operator must evaluate and determine compliance for a facility that is otherwise excluded if specifically requested to do so by the Commission. See 47 C.F.R. §§ 1.1307(c), 1.1307(d); *Local Official's Guide* at 7.

⁷⁰ Parties seeking Commission review of state or local regulation of personal wireless service facilities based on the environmental effects of RF emissions are required to file a request for declaratory ruling pursuant to Section 1.2 of the Commission's rules. See *RF Procedures Report and Order* at 5. These petitions are generally subject to the (continued....)

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In summary, we reiterate our position stated in the *RF Procedures Notice*.⁷¹ As discussed above, while state and local governments have a legitimate interest in ascertaining that personal wireless service facilities will comply with our rules, the Commission has the exclusive authority to determine substantive compliance with its RF exposure regulations.⁷² Given that conformance with our RF exposure rules is a condition of any licensee's authorization,⁷³ certain requests by state or local governments for additional technical showings or requirements may be unnecessarily burdensome on personal wireless service providers.⁷⁴ Of course, we do not here adjudicate any particular local ordinance or regulation. A party that seeks Commission review of a specific state or local government regulation on wireless service facilities based on RF emission considerations should file a request pursuant to the Commission's declaratory ruling process, as described in the *RF Procedures Report and Order*.⁷⁵ Although the principles set forth in the *Local Official's Guide* are still applicable for individual transmitters, we note that we propose in the *Further Notice* significant changes to our categorical exclusion criteria – which are listed in the *Local Official's Guide* – and so we will consider a future technical addendum for this guide to reflect any changes that are adopted.

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Commission's procedures applicable to petitions for declaratory ruling. *Id.*; see, e.g., 47 C.F.R. §§ 1.45-1.49 (filing procedures) and 47 C.F.R. § 1.1206(a)(3) (permit-but-disclose *ex parte* status). However, the Commission, in order to accommodate state and local government entities, adopted both a policy for extended pleading cycles and additional service requirements (petitioners are required to serve a copy of such petitions on the state or local government that is the subject of the petition, as well as on any state or local government that is otherwise specifically identified in the petition as inconsistent with federal law. Petitions that are not served "will be dismissed without consideration."). *Id.* at 5-7.

⁷¹ See WT Docket No. 97-192, *Second Memorandum Opinion and Order and Notice of Proposed Rulemaking*, 12 FCC Rcd 13494 (1997) (*RF Procedures Notice*).

⁷² See *RF Procedures Report and Order* at 8-9.

⁷³ 47 CFR § 1.1307(b)-(e).

⁷⁴ See *RF Procedures Report and Order* at 18.

⁷⁵ See *supra* footnote 70.