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

In the Matter of	)	
	)	
Reassessment of Federal Communications Commission Radiofrequency Exposure Limits and Policies	)	ET Docket No. 13-84
	)	
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 RULE MAKING
AND
NOTICE OF INQUIRY

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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

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 portable[4] 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."

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).

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")

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[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).

(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).

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

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[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.

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 1996[24] 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 exemption[29] 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

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[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, IARCPress, 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).

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*.

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.

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 humans[46] 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*.

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/.

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

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[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.

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 Ericsson[59] 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. APREL[61] 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 802[65] 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.

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[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.

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."

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.

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

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[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.

FDA[81] 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 (RFIAWG Letter) to the IEEE, in which the RFIAWG stated that the IEEE should present a clear rationale for treating the pinna as an extremity.[86] In that letter, the RFIAWG 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

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[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] RFIAWG 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*.

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 RFIAWG.[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 RFIAWG in supporting the evaluations and recommendations of the federal health and safety agencies on these important topics.

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[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).

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.

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 Foundation[101] 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*.

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-133[109] 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.

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*.

remind licensees of their obligation to consider worker as well as public exposure. Finally, we codify in our rules the extent to which occupation/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.

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.

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*.

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 be 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.

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[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*.

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

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[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.

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

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[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*.

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.

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.

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*.

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[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.

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).

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).

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.

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 exemptions[181] 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 Moulder[184] 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*

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[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.

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.

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 license 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 fixed[197] 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.

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]

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[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.

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 alternative[219] 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,

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[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.

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 power[223] from a transmitter is relevant.

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[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*.

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 cm^2. Analogous to the use of a 1-g cube for the case of SAR, 1 cm^2 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*.

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 categories[231] 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….)

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^2f
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 antenna[235] 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.*, $W/m^2/MHz$) 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.

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*.

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 exemptions[244] 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).

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 dBd. Existing classification of amateur exposure as occupational[249] 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.

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[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*.

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 transmitters[255] 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 period[256] 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 SAR[257] 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:

$$\sum_{i=1}^{a}\frac{P_i}{P_{th,i}}+\frac{\sum_{j=1}^{b}SAR_j}{1.6\ \mathrm{W/kg}}+\sum_{k=1}^{c}\frac{ERP_k}{ERP_{th,k}}+\mathrm{AEQ}\geq 1$$

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*.

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 jth 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.

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.

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.

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.*, $W/m^2/MHz$) 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

Frequency (GHz) \ 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

Evaluation is required if either matched conducted or effective radiated power (ERP) is greater than:

$$P_{th}\ (\text{mW}) = ERP_{20cm}\left(\frac{d}{20\ \text{cm}}\right)^{x}$$

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

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

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*.

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_j 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*.

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 jth 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.

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 1[277] and below Table 2[278] 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:

$$\sum_{i=1}^{a} \frac{P_i}{P_{th,i}} + \frac{\sum_{j=1}^{b} SAR_j}{1.6W/kg} + \sum_{k=1}^{c} \frac{ERP_k}{ERP_{th,k}} \geq 1$$

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*.

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 jth 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 λ/2π

166. The proposed portable device exemptions[280] 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/.

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 equations[286] 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.

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[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).

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 cm^2 area for averaging the spatial peak MPE, IEEE Std C95.1-2005 states that 1 cm^2 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 cm^2 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

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[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*.

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.

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[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."

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

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[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 Rcd 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.

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 continuous[305] 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

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[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.

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 Handbook[315] 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.

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[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.

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 references[316] 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.

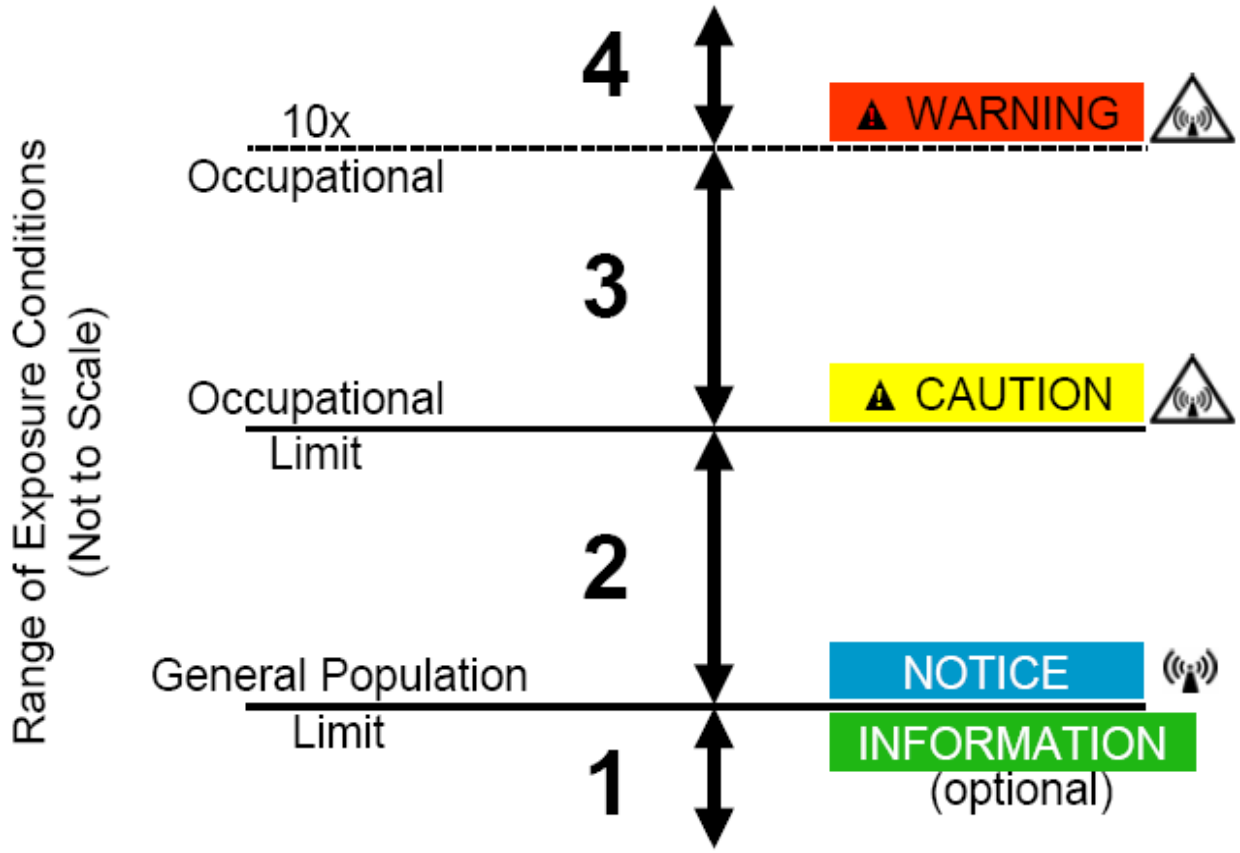
[317] *See* para. 205 *infra*.

[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.

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*.

191. We propose that the determination of the appropriate category should not be based on proposed or existing exemption from routine evaluation[321] 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.

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

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[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.

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]

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[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*.

- **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."

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 proceedings[349] 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

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[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*.

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).

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.

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

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[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).

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 environment[366] 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 1985[368]

[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*.

and updated those limits in 1996[369] 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.

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

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[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.

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 issues[382] 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 1996[384] 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.

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[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.

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.

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 cm^2. 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*.

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.

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 ~18,800,000 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

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[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*.

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]

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[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*.

229. *Frequency Range*. The *1979 Inquiry*[405] 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.

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]

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[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.

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

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[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.

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]

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[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….)

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 it 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* Tubiana M., Centre Antoine Béclère, 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

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*.

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

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[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 Electrotecnical 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/.

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-worn[441] 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

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[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*.

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

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[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.

information be more prominent and detailed[448] 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.

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*.

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).

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

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.

(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,"

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

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

(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:

§ 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.

(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

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.

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.

(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 $\geq$ 19.2R^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 $\lambda/4$.

$$P_{th}\ (\text{mW}) = ERP_{20\,cm}\,(d\,/\,20\ \text{cm})^{x}$$

Where

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

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

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.

$$\sum_{i=1}^{a}\frac{P_i}{P_{th,i}} + \frac{\sum_{j=1}^{b} SAR_j}{1.6\ \text{W/kg}} + \sum_{k=1}^{c}\frac{ERP_k}{ERP_{th,k}} + \text{AEQ} \ge 1$$

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 jth 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:

$$\sum_{i=1}^{a}\frac{P_i}{P_{th,i}} + \frac{\sum_{j=1}^{b} SAR_j}{1.6W/kg} + \sum_{k=1}^{c}\frac{ERP_k}{ERP_{th,k}} \ge 1$$

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.

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 jth 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.

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.

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

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.

(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.

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 λ/4.

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

(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:

$$\sum_{i=1}^{a} \frac{P_i}{P_{th,i}} + \frac{\sum_{j=1}^{b} SAR_j}{1.6\ \text{W/kg}} + \sum_{k=1}^{c} \frac{ERP_k}{ERP_{th,k}} \ge 1$$

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.

$P_{th,i}$ = 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 jth 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

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 λ/4.

$$P_{th}\ (\text{mW}) = ERP_{20cm}(d / 20\ \text{cm})^{x}$$

Where

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

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

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:

$$\sum_{i=1}^{a}\frac{P_i}{P_{th,i}} + \frac{\sum_{j=1}^{b} SAR_j}{1.6\ \text{W/kg}} + \sum_{k=1}^{c}\frac{ERP_k}{ERP_{th,k}} \ge 1$$

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 jth 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:

$$\sum_{i=1}^{a}\frac{P_i}{P_{th,i}} + \frac{\sum_{j=1}^{b} SAR_j}{1.6W/kg} + \sum_{k=1}^{c}\frac{ERP_k}{ERP_{th,k}} \ge 1$$

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.

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 jth 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

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:

§ 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

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

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) * * *

(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.

(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:

§ 97.13 Restrictions on station location.

* * * * *

(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.

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.

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^2f
1,500 – 100,000	ERP $\geq$ 19.2R^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 is $\geq \lambda/2\pi$, 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.

$$S = \frac{2^2 PG}{4\pi R^2} = \frac{2^2 EIRP}{4\pi R^2} = \frac{\left(2^2\right)1.64ERP}{4\pi R^2}$$

Where S = power density (W/m^2), P = power (W), G = antenna gain, and R = distance (m).

Solving for *ERP* in the above equation, $ERP = \frac{\pi S R^2}{1.64}$.

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:

Exposure limit (power density) = $1800/f^2$ W/m^2 where f 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:

Exposure limit (power density) = $f/150$ W/m^2 where f is frequency in MHz.

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/m^2. Using the far-field equation, maximum ERP can be obtained according to:

$$ERP = 19.2R^2$$

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 1-gram SAR limit[1] 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 dependence exponent (-0.5) to relate power density to SAR for normal (perpendicular) plane wave illumination of an infinite uniform planar half-space having standard tissue values of dielectric constant 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.

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 <u>at exactly 20 cm</u> 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

$$S = \frac{EIRP}{4\pi R^2} = \frac{1.64 ERP}{4\pi R^2}, \text{ or } ERP = \frac{4\pi S R^2}{1.64}$$

The first relevant frequency band for these SAR-based exemption criteria is from 0.3 to 1.5 GHz.

$$ERP\ (\text{mW}) = \frac{4\pi(f\ /1.5)(20\ \text{cm})^2}{1.64} \approx 2040\, f$$

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, <u>at exactly 20 cm</u> is:

[4] Mohammod 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.

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

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 $5/\sqrt{f_{(\text{GHz})}}$, 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/cm^2) Computed for Head 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	45.3	43.5	41.5	41.5	41.5	40.5	40.3	40	40	40	39.2	38.5	36.8	35.4	35.3
σ (S/m)	0.87	0.87	0.9	0.97	0.98	1.2	1.29	1.4	1.4	1.4	1.8	2.4	3.94	4.66	5.27
analytical (mW/cm^2)	8.01	6.75	5.66	5.35	5.30	4.39	4.15	3.91	3.89	3.88	3.30	2.85	2.37	2.26	2.22
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 %	14.0	10.4	-3.3	-1.4	-1.3	-5.4	-5.1	-4.5	-6.7	-8.7	-3.4	1.5	-0.5	-3.2	-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.

Table D-2 - **Plane Wave Power Density (mW/cm^2) 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 extensively[9] 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 cm^3 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.

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 $1/\sqrt{f_{(GHz)}}$ 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_{20cm} 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 $60/f_{(GHz)}$ 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 $60/\sqrt{f_{(GHz)}}$ (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 $60/\sqrt{f_{(GHz)}}$ (mW) at 2 cm and the values of ERP_{20cm} 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.

$$P_{th}\ (\text{mW}) = ERP_{20\,cm}\,(d\,/\,20\ \text{cm})^{x}$$

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

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_{20cm}). 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*.

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, which ever 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 research[15] 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*.

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*.

Table D-3 – **Threshold Powers (mW) at Selected Frequencies (GHz) and Distances from 0.5 to 20 cm**

Distance (cm)

Frequency (GHz)	**0.5**	**1**	**1.5**	**2**	**2.5**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**12.5**	**15**	**17.5**	**20**
0.3	39	65	88	110	130	150	180	220	250	280	310	340	360	430	490	550	610
0.45	22	44	67	89	110	130	180	230	270	320	360	410	460	570	690	800	920
0.835	9.2	25	44	66	90	120	170	240	310	390	470	550	640	900	1100	1400	1700
0.9	8.3	23	42	63	88	110	170	240	320	400	480	570	670	900	1200	1500	1800
1.45	4.3	15	30	50	74	100	170	250	350	460	580	720	870	1300	1800	2300	3000
1.8	3.5	13	26	45	67	94	160	240	340	450	570	710	860	1300	1800	2400	3060
1.9	3.4	12	26	44	66	92	160	240	330	440	560	700	850	1300	1800	2400	3060
2.45	2.7	10	22	38	59	83	140	220	310	420	540	670	820	1300	1800	2400	3060
3	2.3	9.0	20	35	53	76	130	210	290	400	510	650	790	1200	1700	2400	3060
5.2	1.5	6.3	15	26	42	61	110	170	250	350	460	590	730	1200	1700	2300	3060
5.8	1.4	5.9	14	25	40	58	110	170	250	340	450	580	720	1100	1700	2300	3060

Table D-4 – **Estimated 1-g SAR (W/kg) for λ/2 Dipole Corresponding to the Threshold Powers in Table D-3**

Distance (cm)

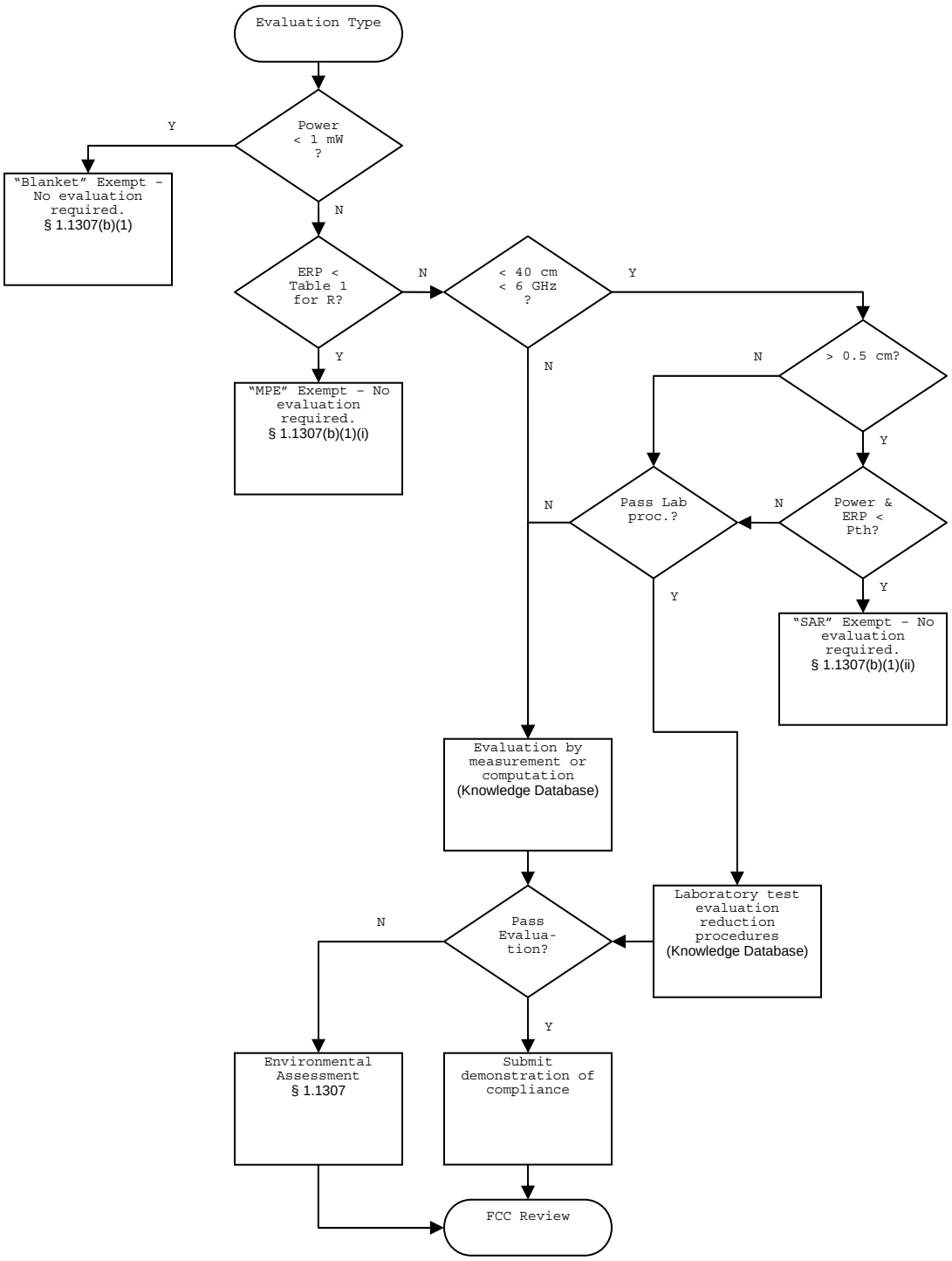
Frequency (GHz)	**0.5**	**1**	**1.5**	**2**	**2.5**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**12.5**	**15**	**17.5**	**20**
0.3	0.17	0.23	0.27	0.29	0.29	0.30	0.28	0.26	0.23	0.20	0.17	0.14	0.12	0.08	0.05	0.04	0.03
0.45	0.16	0.26	0.33	0.37	0.39	0.38	0.38	0.34	0.28	0.23	0.18	0.16	0.13	0.08	0.06	0.04	0.04
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	0.11
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	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	0.22
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	0.26
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	0.25
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	0.32
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	0.34
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	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	0.47

Table D-5 – **1-g SAR of λ/2 Dipole at 1.0 W Input (Computed with NEC-4 using dipole specs from IEEE 1528 & IEC 62209-2)**

Distance (cm)

Frequency (GHz)	**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**	**20.0**
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	0.05
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	0.04
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	0.07
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	0.07
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	0.07
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	0.09
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	0.08
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	0.10
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	0.11
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	0.15
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	0.15

Figure D-1 – General Sequence for Determination of Procedure to Establish Compliance with Exposure Limits for a Single RF Source



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 l996 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.

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[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).

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 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.

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[6] 5 U.S.C. § 603(b)(3).

[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 (continued….)

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)

(Continued from previous page)
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 89,746 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.

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 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

[23] http://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517919&search=2007%20NAICS%20Search.

[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).

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]

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[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….)

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.

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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.

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).

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*").

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

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[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*").

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.

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[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. Upper700 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).

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

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[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*.

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).

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.

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[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).

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,

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[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.
(continued….)

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

(Continued from previous page)

[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 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).

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

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[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.

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.

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[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 Rcd 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.

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]

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[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*.

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, Teligent[169] 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

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[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).

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.

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[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.

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) affiliations[190] 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]

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[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.

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.

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

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[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.

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 entities[209] 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.

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[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.*

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).

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 l996 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).

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.

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[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 89,746 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.

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.

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

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[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).

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).

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

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[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.

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).

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*").

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

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[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*").

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.

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[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. Upper700 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).

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

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[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*.

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).

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.

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[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).

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.

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 small business size standards for the 218-219 MHz Service and defined a small business as an entity that,

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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 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).

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 Radiotelephone Service, and under that definition, we estimate that almost all of them qualify as small

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[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.

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.

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[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 Rcd 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.

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]

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[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*.

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, Teligent[169] 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

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[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).

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.

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[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.

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) affiliations[190] 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]

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[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.

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.

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

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[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.

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 entities[209] 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.

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[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.*

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).

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)

(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, IPSG
(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)

(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.

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.

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).

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 transmitters[13] 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.

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[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)).

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.

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 computers[31] 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

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[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.

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.

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[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.

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.

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.*

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.

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 62232[52] 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….)

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.

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]

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[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….)

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.