**Before the**
**FEDERAL COMMUNICATIONS COMMISSION**
**Washington, DC 20554**

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| In the Matter of | ) | |
| | ) | |
| Targeted Changes to the Commission's Rules | ) | |
| Regarding Human Exposure to Radiofrequency | ) | ET Docket No. 19-226 |
| Electromagnetic Fields | ) | |
| | ) | |

To: The Commission

**REPLY COMMENTS OF ARRL,**
**THE NATIONAL ASSOCIATION FOR AMATEUR RADIO**

ARRL, the National Association for Amateur Radio ("ARRL"), submits these reply comments to the Federal Communications Commission's ("FCC" or "Commission") proposals to adopt additional policies to regulate radiofrequency exposure limits in the above-referenced proceeding.[1] As noted in its initial comments, ARRL's principle concern with the Commission's proposals for below 10 MHz and above 6 GHz is the need for clear and practical means for radio amateurs to determine compliance of their stations. Any such measures must be straight-forward and accessible to the radio amateur operators using the bands at issue by applying Maximum Permissible Exposure ("MPE") levels for stations evaluations. In addition, the Commission must ensure that any rules adopted for wireless power transfer ("WPT") devices protect against harmful interference to other operators – including Amateur Radio Operators. The following is respectfully shown:

[1] *See In the Matter of Targeted Changes to the Commission's Rules Regarding Human Exposure to Radiofrequency Electromagnetic Fields,* Resolution of Notice of Inquiry, Second Report and Order, Notice of Proposed Rulemaking, and Memorandum Opinion and Order, 34 FCC Rcd 11687 (rel. Dec. 4, 2019) ("*NPRM"*).

## I. ANY COMMISSION ACTION MUST RESULT IN CLEAR AND PRACTICAL MEANS FOR RADIO AMATEURS TO DETERMINE COMPLIANCE OF THEIR STATIONS

The Commission proposes to apply new requirements for RF Exposure compliance, primarily related to electrostimulation concerns, for frequencies between 3 kHz and 10 MHz,[2] which includes the amateur bands from 2200 meters (135.7 kHz) to 40 meters (7.3 MHz). Specifically, the Commission proposes to overlay the International Commission on Non-Ionizing Radiation Protection ("ICNIRP") 2010 electrostimulation limits on the existing Specific Absorption Rate ("SAR") limits for frequencies between 100 kHz and 10 MHz.[3] This proposal represents a new paradigm in the current regulations concerning RF safety. Although ARRL supports RF safety limits based on industry consensus standards, it is critical that the obligations of licensees be specifically spelled out in the rules, and are able to be carried out by amateur licensees.

Currently, the Commission has set Maximum Permissible Exposure ("MPE") limits that, if met, are assumed to meet the SAR limits.[4] Amateur licensees currently are using the existing MPE limits for RF exposure evaluation purposes due to their ease of use.[5] Unfortunately, both the SAR and electrostimulation measurements and calculations are beyond the capabilities of the vast majority of individual licensees, including operators on the Amateur Radio Service – as other measurement methods are both prohibitively expensive and require technical capabilities generally found in specialized laboratories or by using expensive software that requires

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[2] *See id.* ¶ 123.

[3] *See id.* ¶ 124.

[4] *See id.* ¶ 122.

[5] *See* Petition for Clarification of ARRL, the Nat'l Ass'n for Amateur Radio, ET Docket No. 03-137 (terminated), ET Docket No. 13-84 (terminated), ET Docket No. 19-226, at 4 (filed May 8, 2020) ("ARRL Petition for Clarification").

specialized skills to use.[6] In contrast, it is possible, using relatively simple calculations, to determine what locations from a particular transmitter and antenna system will result in field strength and/or power density at or below specified MPE limits – and to determine that human exposure does not occur where time-averaged field strength or power density exceeds the limits at any given exposure point. Unlike SAR, electrostimulation effects have an almost instantaneous cause-and-effect relationship, so the time-averaging for SAR and the existing application of MPE limits cannot be applied as the proposed rule is written.[7]

The adoption of this rule without modification could result in confusion when evaluating a station's RF exposure compliance. Although the ICNIRP standard does consider electrostimulation at frequencies greater than 100 kHz, as noted by the FCC, electrostimulation occurs above 100 kHz only for RF sources occurring only in extremely short pulses.[8] ARRL noted in its comments that it is not aware of any known modulation technique used by amateurs that approaches pulse lengths of pulses in the hundreds of microseconds – and, in fact, such pulses would not be permitted on HF or below by the Part 97 rules.[9] Indeed, the FCC notes that "MPE and SAR" exposure limits will reliably protect against any adverse tissue heating from most (if not all) communications sources of RF energy regulated by the Commission . . ." and that "extremely fast, short-duration pulses of energy [are] not common from communications

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[6] ARRL Petition for Clarification at 5-6.

[7] *NPRM*, 34 FCC Rcd at 11748-49, ¶ 131, 132.

[8] The FCC notes that "[n]eural stimulation time constants are measure in hundreds of microseconds . . . as compared to thermal time constants for RF heating of skin of typically measured in tens or hundreds of seconds." *NPRM*, 34 FCC Rcd at 11744 n.331.

[9] *See* Comments of ARRL, The Nat'l Ass'n for Amateur Radio, ET Docket No. 19-226 at 3 (filed Jul. 17, 2020) ("ARRL Initial Comments").

devices over the frequency range in which these limits would apply."[10] Consequently, it is unlikely that the electrostimulation limits over 100 kHz would occur for Amateur Licensees in real-world scenarios.

Accordingly, any adopted rule should include language clarifying that only stations employing the very short pulse modulation(s) of concern need to evaluate electrostimulation under the new limits. For frequencies above 100 kHz, the rule should also specify the pulse width limit that would exempt transmitters who meet that limit from having to evaluate stations against electrostimulation limits – and note that the time-averaging of MPE limits can continue to be applied for such longer pulses. These specifications should be articulated either in the rules, or in additional FCC materials such as OET Bulletin 65, OET Bulletin 65 Supplement B (Amateur Radio) and the FCC Knowledge Database.

Moreover, ARRL recommends, as noted in its earlier Petition for Clarification, that MPE limits be included in Table 1 at Section 1.1310(e)(i) down to 100 kHz based on the guideline or standard used as a basis for the Commission's regulation.[11] MPE limits should also be included in the amendments to the associated rule and be permitted explicitly for evaluations of stations operating in the 2200-meter band.[12] These changes make sense because, as noted above, most Radio Amateurs use the existing MPE limits for RF exposure evaluation purposes due to their ease of use, and both the ICNIRP and Institute of Electrical and Electronics Engineers ("IEEE") standards now extend the MPE tables and limits below 300 kHz.[13] However, the current Table 1

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[10] *NPRM*, 34 FCC Rcd at 11744-45 n.332.

[11] *See* ARRL Petition for Clarification at 4; *see also* Comments of Hammett & Edison, Inc., Consulting Engineers, ET Docket 19-226 at 1-2 (filed June 16, 2020).

[12] ARRL Petition for Clarification at 4.

[13] *Id*. at 5.

only extended to 300 kHz,[14] so there remains a technical issue of whether use of MPE by amateurs for the 2200-meter band would comply with the letter of the regulation. Accordingly, the FCC should apply current MPE limits to all spectrum and circumstances where the use of MPE to assess compliance with the overlying SAR and electrostimulation limits is appropriate. The Commission should ensure that the MPE limits in the new rules, or associated FCC documentation, appropriately extend the MPE tables and limits to all frequencies covered in the standards. Moreover, the Commission should adopt the proposal set forth in the Petition for Reconsideration of the National Spectrum Managers Association to extend the two-year timetable for implementation of site-by-site RF exposure evaluation.[15]

ARRL also supports the request by the IEEE ICES Committee for the Commission to use the C95.1 standard as the basis for limits and compliance. This standard is the more comprehensive resolution of electrostimulation effects and appropriate safety levels. The C95.1 standard is clear that determination of controlled and uncontrolled environments should be based on training, not just occupational status. It is a consensus standard, not a 'guideline' and is based on a broad consensus of engineers, medical professionals, users of the standard and regulators.

## II. ANY RULES ADOPTED WITH RESPECT TO WIRELESS POWER TRANSFER MUST PROTECT EXISTING SERVICES FROM HARMFUL INTERFERENCE

ARRL appreciates the Commission's efforts to promote and advance newer technologies, such as Wireless Power Transfer ("WPT") devices, that allow for the transmission of electrical

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[14] *Id*. at 4.

[15] Petition for Reconsideration of the Nat'l Spectrum Managers Ass'n, ET Docket No. 03-137 (terminated), ET Docket No. 13-84 (terminated), ET Docket No. 19-226 at 2-3 (filed Apr. 6, 2020). This is particularly important since the Commission has indicated that it is revising OET Bulletin 65, Supplement B, which many Amateur Licensees rely on for proper compliance with FCC rules. The Commission should allow Amateur Licensees to determine compliance two years from the date that a new version of Supplement B is published by the Commission.

energy without the use of wires or other connections.[16] However, the Commission should ensure that existing licensed operations are not disturbed by these newer technologies. The Commission must apply rules to WPT devices that apply to all types of WPT operations, with appropriate in-band limits, appropriate limits for spurious emissions, and clearly defined and understood mechanisms by which harmful interference to licensed radio services can be addressed if such harmful interference occurs.

The Commission notes that WPT devices generally operate under Part 15 or Part 18 generic limits for low-power devices (10W transmit power or less) or under Part 18 rules.[17] The existing limits on spurious emissions currently defined in those rules are sufficient for many circumstances because the low-power operations of Part 15 and 18 devices limit the geographical area over which interference is possible. If interference from a low-power WPT device does occur, it is generally going to be from a device that is in very close proximity to a licensed radio receiver, which is relatively easy to locate and mitigate. Moreover, low-power WPT devices operating below 500 kHz have generally been successfully deployed in residential areas. Lastly, to ARRL's knowledge, no existing low powered WPT device has its fundamental frequency on any band allocated to the Amateur Radio Service.

Newer technologies, however, such as multi-kilowatt chargers being developed to wirelessly charge automotive battery systems, are an entirely different animal.[18] These types of devices would exceed the generic limits of Part 15 or Part 18, as the devices by their very nature

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[16] *NPRM*, 34 FCC Rcd at 11751, ¶ 137.

[17] *See id.* ¶ 139

[18] ARRL has previously submitted comments discussing how WPT used for electric vehicle ("WPT-EV") applications entails upward of eleven kilowatts and therefore requires "substantial evaluation" of the interference potential. Comments of ARRL, The Nat'l Ass'n for Amateur Radio, RM-11815 at 3 (filed Oct. 28, 2018) ("ARRL WPT-EV Comments"); *see also NPRM*, 34 FCC Rcd at 11744 n.328.

must radiate power at their fundamental frequencies. Furthermore, the ubiquitous deployment of devices that operate with tens of kW of transmit power in residential areas is unprecedented.[19] These devices have not been tested in non-industrial environments, so the Commission must consider appropriate limits on spurious emissions that are necessary and appropriate to the uniqueness of this use and that offers legitimate protection to licensed users of spectrum. The Commission must also rigorously control non-fundamental emissions from these higher powered WPT devices.[20] The Commission should be cautious and conservative with respect to protecting against harmful interference.

Any actions that the Commission takes to implement new rules and/or frequency bands for WPT devices should ensure that amateur licensee operations are protected. First, the Commission should not allocate any existing Amateur Radio Service bands for new WPT options.[21] Second, any rules adopted by the Commission pursuant to this proceeding must protect against harmful interference into Amateur Radio Service bands. It is reasonable to

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[19] Traditionally, WPT has only been used for low-power devices and Part 18 rules likely would not offer the appropriate regulatory paradigm for high-power devices deployed in residential environments. *See* ARRL WPT-EV Comments at 3.

[20] Sources of emissions on frequencies other than the fundamental frequency of an WPT-EV system could include (a) high-order harmonics of the fundamental WPT frequency; (b) phase noise from the frequency control circuits ("jitter") causing wideband noise; (c) spurious signals from the switch-mode power supply on all control and power ports – conducted and common mode; and (d) common-mode signals on control cables and power lines from data communication networks associated with the control of the unit. *See* ARRL WPT-EV Comments at 7.

[21] The Commission should confine emissions from any kind of WPT to the frequency ranges already identified for industrial, scientific, and medical ("ISM") applications. Additionally, the Commission should not include the amateur 2200-meter band within any designated ISM allocation because regulators created ISM bands specifically to designate certain spectrum as appropriate for ISM devices operating at high-power levels. *See NPRM*, 34 FCC Rcd at 11704, ¶ 31. The Part 18 rules would permit ISM devices to operate on any spectrum except the restricted bands, at no more than the levels of spurious emissions that Part 18 defines for non-ISM frequencies. This should only be changed through the creation of a designated ISM frequency or frequency band, in accordance with how all ISM devices are treated under the ISM rules.

expect that as new technology is developed and deployed, emissions limits will not be so high that existing noise levels are significantly increased. The existing levels of man-made noise are described to the best-available international consensus in the International Telecommunications Union, Radio Communications Sector ("ITU-R") document *P372.14, Radio Noise*.[22] Any adopted rules in this proceeding should be based upon those internationally accepted guidelines. Accordingly, ARRL recommends that the Commission adopt limits for high-power WPT device operations at a distance of 10 meters that will result in no more than a 1-dB increase in the median values of man-made noise for residential environments described in ITU-R document *P372.14, Radio Noise*. Such a limit will provide the necessary protections to existing licensees.

Lastly, ARRL disagrees with Energous' proposal that WPT devices should be permitted to conduct communications to enable more efficient system controls.[23] The premise of the Part 18 rules is that it is radiofrequency energy, not information, that is being transmitted. This helps ensure that the bandwidth of the energy being used is minimal on its fundamental frequency, and, more importantly, on harmonics and other spurious emissions. ARRL is concerned about the proposed change because if a WPT device were operating on 100 kHz, simultaneously transmitting data with a modest 3 kHz bandwidth on its fundamental frequency, harmonics that were present on HF spectrum would, at 10 MHz, have 300 kHz bandwidth, with a single harmonic or other spurious emission occupying the entire 10.1-10.15 MHz amateur band. Allowing the higher-powered transmission of data that only needs to communicate across no more than a few meters of distance is not supportable in light of the increased risk of interference. This is particularly true since such transfer of information is already allowed and

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[22] R*ecommendation ITU-R P.372-14, Radio Noise*, INTERNATIONAL TELECOMMUNICATIONS UNION (Aug. 2019), https://www.itu.int/dms_pubrec/itu-r/rec/p/R-REC-P.372-14-201908-I!!PDF-E.pdf.

[23] *See* Comments of Energous Corp., ET Docket No. 19-226 at 13-14 (filed June 17, 2020).

appropriate under Part 15;[24] via modules that are already permitted, inexpensive, and widely used by many systems that need to communicate data over short distances.

## III. CONCLUSION

ARRL respectfully requests that the Commission consider two key recommendations to protect radio amateur operators. First, to account for the overly burdensome requirements for SAR and electrostimulation testing and the low likelihood that electrostimulation would occur above 100 KHz for most RF sources, ARRL urges the Commission to clarify its proposed rule to only require stations employing extremely short pulse modulations to adopt the new testing requirements. Second, due to nascent technology like wireless automotive battery charging systems presenting potentially significant harmful interference concerns, ARRL asks the Commission to take necessary actions to prohibit harmful interference into existing Amateur Radio Service bands.

Respectfully submitted,

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[24] *See* Comments of WiTricity, ET Docket 19-226 at 1-2 (filed Apr. 27, 2020).