ARRL EMC Committee Semi-Annual Report

Doc. # 16

For The
American Radio
Relay League

Board of Directors Meeting
January 18th and 19th

Submitted By
Kermit Carlson, W9XA
Chairman, ARRL EMC Committee

Mission Statement:

The EMC Committee monitors developments in the Electromagnetic Compatibility (EMC) field and assesses their impact on the Amateur Radio Service. The Committee informs the ARRL Board of Directors about these activities and makes policy recommendations for further action, if appropriate.

The overall goals of the committee are:

- Advise the ARRL Board about issues related to radio-frequency interference
- Advise the ARRL HQ staff on the content of its publications
- Make recommendations to the ARRL Board and HQ staff
- Maintain contact with other organizations involved in EMC matters through established liaison individuals

Members of the Committee:

- Mr. Kermit Carlson, W9XA, ARRL Central Division Director, EMC Committee Chairman
- Mr. Gordon Beattie, W2TTT, Principal Technical Architect, AT&T Enterprise IT Service Assurance
- Mr. Jody Boucher, WA1ZBL, RFI troubleshooter, Eversource, retired
- Mr. Brian Cramer, PE, W9RFI, Electrical Interference Solutions, Inc.
- Mr. Paul A. Cianciolo W1VLF, ARRL Lab RFI Engineer, HQ Staff Liaison
- Mr. Ed Hare, W1RFI, ARRL Laboratory Manager
- Mr. Ron Hranac, N0IVN, Technical Leader, Cisco Systems; past member of the Board of Directors, Society of Cable Telecommunications Engineers
- Dr. Gregory Lapin, N9GL, Chair ARRL RF Safety Committee
- Mr. Jerry Ramie, KI6LGY, ARC Technical Resources, Inc.
- Mr. James Roop, K9SE, past FCC District Director

- Dr. Steve Strauss, NY3B, Home Phone Networking Alliance Technical Committee
- Dr. Richard E. Dubroff, W9XW, Professor Emeritus at Missouri University of Science & Technology
- Mr. Bob Allison, WB1GCM, Assistant ARRL Laboratory Manager
- Mr. Ed B. Hudgens, WB4RHQ, ARRL Delta Division Vice Director
- Mr. Carl Luetzelschwab, K9LA, ARRL Central Division Vice Director
- Mr. Riley Hollingsworth, K4ZDH, ARRL Atlantic Division Vice Director

HQ Staff:

The role of the ARRL HQ staff consists of the following:

- Answer individual inquiries from hams (and sometimes their neighbors) about RFI problems
- Write, review and publish articles about RFI
- Write and publish the ARRL RFI Book
- Design and update ARRL's RFI web pages
- Produce video content pertaining to RFI
- Maintain a database at ARRL to facilitate EMC case tracking and reporting
- Work with ARRL's D.C. office on various spectrum and RFI-related filings
- Maintain contact with industry
- Participate in standards and industry groups, as a voting member or as a liaison. This includes ANSI accredited C63®, Society of Automotive Engineers EMC and EMR committees, Home Phone Networking Alliance, VDSL, HomePlug, FCC and individual companies.

Mr. Gruber has retired as of November 2018. Paul Cianciolo W1VLF is taking over the responsibilities of ARRL Lab's EMC engineer. Paul handles the majority of the staff work on EMC matters. In the 1st half of 2019, he will continue working in several key areas:

- Adding updates and revisions to the ARRL RFI Web pages.
- Facilitating and providing assistance on resolving long standing power line noise cases with the FCC.

1) Testing the conducted emissions of suspect consumer electronic and electrical devices. Devices that exceed FCC specified absolute limits can be identified and reported to the FCC. Of particular concern are lighting devices, including LED and grow lights. Issues concerning grow lights have been discussed in previous EMC Committee reports. On November 21, 2018, the FCC issued a press release that indicated that it had reached 21 settlement agreements with LED-device manufacturers, netting total forfeitures of $850,000. Although settled primarily on the basis of labeling violations, in the agreements, all of the companies indicated that they will comply with all FCC rules that apply to the devices that they manufacture.

2) Residential and commercial LED Lighting is a growing issue. Some states are mandating efficient lighting on new construction which means LED lightning. The solid-state drivers/ballast are the chief causes. Commercial establishments wishing to lower energy costs are moving toward utility subsidized LED lighting fixtures. Some of which are causing RFI. These are being handled by ARRL staff, but the EMC Committee is continuing to monitor this as a potential threat to Amateur Radio.

3) Variable speed pulsed DC motors now appearing in such things as washing machines, HVAC systems and pool pumps. Furnaces and air conditioners seem to be particularly problematic and difficult to resolve.

ARRL has received complaints involving several different types of HVAC equipment. One of these companies is Mitsubishi, the manufacturer of the HVAC system used at ARRL HQ. Paul Cianciolo has established a contact within Mitsubishi technical resources. Alex Stephens, one of the Mitsubishi engineers, is bringing the issue of ECM RFI up at the Mitsubishi HVAC technical staff meetings for review. No engineering takes place in the USA, so the issues will be forwarded to the engineering in Japan. Specific model numbers of Mitsubishi equipment generating RFI have been given to Mr. Stephens. This is a new contact into Mitsubishi, as of January 7, 2019 so the resolution of these problems is still in progress. ARRL is pleased that Mitsubishi is looking into the problems.

4) Complaints involving solar PV systems continue to be on the rise. Several specific cases have been forwarded to Solar Edge, the major manufacturer of the RFI generating equipment. Although contact has been made, there are cases pending that do not appear to have been rectified. US technical staff of this company have been quite cordial and accommodating during phone conversations. However, they can only act on the case, when dictated to do so by the corporate offices in Israel, the country of manufacture. Solar Edge has successfully resolved a number of complaints and it has indicated that it will continue to respond to RFI problems as they occur.

5) Wireless Power Transfer (WPT) systems. While there haven't been any reported cases of interference so far, this emerging technology could have the potential to cause significant interference problems. This may be particularly true in cases involving high power, such as in a system used to charge an electric vehicle. We continue to monitor WPT development through the use of internet resources.

6) Power line noise remains a significant problem facing hams today. Cases can drag on for years without meaningful FCC enforcement, often leading to frustration on the part of the ham.
7) Working with AT&T engineering staff to help resolve RFI issues with U-Verse and other broad band systems.

8) Reviewing proposed EMC related material for ARRL publications.

Summary of Recent and Ongoing Lab Activities

Working Group for Recommended Practice of Locating Power Line Noise

The IEEE has created a standards working group (WG) to develop an IEEE Recommended Practice that describes to power companies what procedures they can use to respond to customer complaints about electrical noise. Although he has retired from ARRL, Mike Gruber will continue to Chair this Working Group. p a Recommended Practice for Location of Power Line Gap Noise. See **Committees** section for additional details. EMC Committee member Jerry Ramie, also serves as the Working Group's secretary.

Grow Lights

Grow light continue to be an issue. At the present time, Paul Cianciolo refers a suspected grow light case to Laura Smith for follow-up. Ms. Smith then sends a suspect grower a letter without mentioning the ham or Amateur Radio. In cases where the FCC letter is ignored, however, specific FCC enforcement action has not been occurring.

Other Lighting Devices

Paul Cianciolo reports that interference from lighting devices seems to be on the rise. Much of the problem to be caused by switching mode power supplies in low voltage lighting products. Some states mandate efficient lighting in new construction. Leading to wholesale installation of LED bulbs Another issue has been dimmers for LED bulbs.

It should also be noted that LED bulbs can be legally marketed and sold if their emissions are close to the FCC limits. The emissions in this case could be high enough to create interference issues even from nearby residences in a typical suburban neighborhood. If and when such interference occurs, the burden then falls on the device *operator* to correct problem. While this rule may work on a case-by-case basis involving a small or limited number of sources, it is not practical should many bulbs in several houses be contributing to a wide spread problem. This issue has been demonstrated in an actual case in California.

An additional problem involves the sale and marketing of non-consumer rated ballasts to consumers in hardware and big box stores. These ballasts are still being sold to unsuspecting consumers and have been the subject of interference complaints to the ARRL Lab.

Solar PV Systems

As previously reported, Paul Cianciolo has determined that most of the complaints involved products made by one manufacturer. As a result of a subsequent teleconference with the company's engineer and attorney, the company agreed to provide a channel for ARRL to forward complaints. In turn, they agreed to address these issues on a case-by-case basis.

Since that time, the company has been responsive and appears to be making a good faith effort toward resolving these problems. As a result, some cases appear to have been fixed the Amateur's satisfaction. However, some issues did occur along the way.

- While not necessarily an issue, it should be noted that newer cases are ongoing and have not been corrected at the time of this report.
- Repairs have not always occurred in a timely manner. This, in part, appears to have been as a result of a need to find the right approach toward solving these issues.
- The company appears to have been initially uncertain as to how to best solve the interference.

The success rate and timeliness of the repairs has yet to be determined. Of late resolution to complaints appear to be happening at a slower rate that previously noted. Equipment from other companies, however, may be a different matter.

It should also be emphasized that the proliferation in residential solar PV systems can aggravate the situation. Should interference occur, there may be multiple sources, making it more difficult for hams with without specialized equipment to locate. At least 1 case has been reported to the manufacturer where multiple PV arrays are causing RFI. In many case Amateurs have already expressed concerns about the difficulty in locating the source systems when confronted with many systems in their neighborhood. This may be a real issue, especially if all buildings in the area have PV systems on them. As an example, this may soon be the situation in California, where State law requires all new buildings to have PV systems on them. In addition, there numerous companies that install PV systems country wide. One big stumbling block is acquiring contacts within these companies, with the intention on determining what type of equipment has been installed at a particular location. This information is necessary for ARRL to be able to contact the manufacturer and attempt a resolution.

Power Line Noise

On February 28, 2018, Messrs. Hare and Gruber assisted two FCC field agents in locating some noise sources that were plaguing the East Hartford, Connecticut, fire alarm system. This system is operated by the City's Fire Department, and power line noise has been severe enough to render several alarms in the system inoperable when using a new receiving system at the fire station.

Messrs. Hare and Gruber demonstrated the use of Radar Engineers equipment, and located several sources at the time of their visit. The utility in this matter, Eversource, subsequently hired Mike Martin, a well-known professional RFI investigator, to perform a complete RFI investigation in May. ARRL staff continue to monitor this problem, but so far, the system appears to be working correctly.

Wireless Power Transfer Systems

Messrs. Hare, Allison and Carlson held a Webinar with Gene Saltzburg, AB2ZM, of General Motors on June 19, 2018. The purpose of this discussion was wireless charging systems for electric vehicles, and the potential for interference that they cause. While it is premature to say for certain what interference this emerging technology may cause, the potential would seem to be there. Mr. Saltzberg was able to share some helpful information in this area. See Appendix 1 for additional information.

Status on FCC Enforcement and Outstanding EMC Cases

Note:
Due to government shut down the ARRL FCC contact has been furloughed and cannot by law take any actions or communicate until further notice.

Paul Cianciolo reports that the FCC continues sending letters to utilities (and consumers) with some regularity. Specific enforcement beyond that, however, continues to be lacking. To the best of his knowledge, no previously reported longstanding power line noise case has been resolved during the second half of 2018 due to enforcement. While some cases have been closed, many cases can drag on indefinitely. Protracted cases are often caught in an endless loop or letter writing campaign. As a result, new cases can develop faster than old cases are resolved. There has been little or no change from the previously reported statics in this regard. **The FCC has yet to issue even one NAL in a case of interference to Amateur Radio from a Part 15 or Part 18 device. Yet – some cases have dragged on for over a decade without resolution.**

So far, most cases involving Amateur radio have been argued on the basis of harmful interference as opposed to exceeding the FCC emissions limits. The FCC rules place the burden to correct harmful interference on the *operator* of the offending device – not the distributor or manufacturer. Device operators in a typical RFI case include a power company or neighbor.

In a typical case, one or more letters will be sent by the FCC in Gettysburg to an offending device operator. Beyond that, a typical case will be referred to the local FCC field office for an investigation. From what we've seen, most field investigations result in a conclusion of convenience. As a typical example, the agent may conclude that the

noise is insufficient to meet the criteria for harmful interference, thus ending the case. Other complainants have reported a lack of follow-up after an investigation, especially if the source was not active during the initial field investigation. Two examples that come to mind include:

- An apparent grow light case that resulted in a field investigation after some time: The agent conducted the investigation when the lights were off and closed the case. The agent had not checked to see when the lights were typically on and declined to return when the lights would likely be on.

- An apparent doorbell transformer case that resulted in an FCC field investigation: The source was located in a home and, and with modern locating equipment, most sources like this are relatively easy to find. Despite an offer to loan our Radar Engineers Model 245 locator, the FCC declined our offer and the problem continues. The current status of this case with the FCC is unknown at this time.

It appears that FCC field agents do not always have the proper training or equipment to correctly identify and locate power line and other noise sources. Their equipment seems better suited for locating such things as transmitters. Even if the source is known, or if the source is a consumer device in a nearby home, we've yet to see one in which the FCC issued an NAL or forfeiture. Some cases like this have dragged on for a considerable period of time with no resolution.

Finally, from what we've seen so far, the FCC Field Office reduction continues to have a significant and negative impact on FCC field resources. Despite the Commission's enthusiastic claims for a centralized "Tiger Team" approach, it has only made matters worse. To the best of Paul Cianciolo's knowledge, it has yet to be even one Amateur case investigated by a Tiger Team. It also appears that FCC enforcement issues have become problematic for other radio services as well.

FCC Enforcement Concerns

While a lack of meaningful enforcement in cases involving device operators has been the norm for a considerable period of time, the issues described in the previous EMC Committee reports remain ongoing. A brief summary includes but not limited to:

1. Grow lights and other devices being marketed and sold that exceed the FCC limits, in some cases by a considerable margin.
2. Illegal marketing of Part 18 non-consumer lighting devices. Non-consumer devices are being marketed to consumers for residential environments. These devices are only intended for commercial and industrial environments.
3. Field investigations are almost non-existent with abnormally long waiting times.
4. Field investigations being conducted in such a way that the outcome will not be favorable to the Amateur. Examples include cases in which the investigation took

place at times when the source was known to be off, checking for noise at random (unaffected) frequencies, etc.

It must be emphasized that any FCC enforcement effort in any of these matters will have the maximum impact if it takes place in a timely fashion. Some cases have been ongoing for a considerable period of time with no known formal FCC action. Even if there was to be an FCC action at this point, it would not be timely enough to achieve maximum impact as a future deterrent.

With the proliferation of new types of electronic devices and technology, some of which have the potential to cause a considerable interference problem, some meaningful FCC enforcement is badly needed. A lack of enforcement in RFI matters would no doubt be disastrous for both hams and other services as well. If the FCC does nothing about something as egregious as grow lights, or proper follow-up it to a Citation & Order, or illegal marketing of industrial devices, it would fundamentally call into question the FCC's credibility as an enforcement body. It would also seem unlikely that meaningful enforcement could be expected in other interference matters as well.

Second Half 2018 Year Total RFI-Case Statistics:

New RFI Cases – 78
New electrical power-line cases – 22

- ARRL Letters sent – 11
- FCC 1st Letters submitted – 3 (Note: Laura Smith may have issued FCC letters based on need and input from the ARRL. These letters were not formally submitted by ARRL and therefore not included in this total. Many of these letters could possibly be follow-up in nature and therefore require custom legal language. The effectiveness of these letters has yet to be determined.)
- FCC 2nd Letters submitted – 1
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<u>Smart Grid & EMC Standardization Efforts</u>

Mr. Ramie, KI6LGY, updates our efforts in these areas:

1) IEEE-P1613 Standard for Environmental and Testing Requirements for Devices Installed in Transmission and Distribution Facilities

The draft document is very near completion, but there was no political will to have the document cover products that are addressed in other Power & Energy groups. Including devices that are not protective relays has turned this development into several turf battles. A series of webinar meetings were set to de-scope the document to only cover the communications port of devices, not any of the other ports. The reduced scope was approved at our last meeting in Minneapolis last year. This de-scoping to only cover the COM port allows us to regulate the entire product by operating it over the communications interface as in the real world. If you regulate the COM port, you

regulate the box itself. The reduced scope allows us to move forward. We will take up this issue again next week at the P&E meetings in Garden Grove, CA.

2) IEEE-C37.90.1 Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus

This document covers both Electrical Fast Transient (EFT) and Surge Withstand Capability (SWC) for protective relays. These are products that open output circuits to prevent damage to equipment in the event of faults. (shorted outputs) The EFT section needs updating to the higher repetition rates in the more recent IEC 61000-4-4 and the SWC section need additional ringing frequencies to cover Gas Insulated Substations as in IEC 61000-4-18, which are small with short lines that ring-down at higher frequencies from switching operations. (like the shorter strings of a piano) I expect fairly heavy push-back from the dominant personality in this group, Mr. Beckwith, to any change he didn't author. We will discuss these changes in Garden Grove next week. I expect lots of complaints about these straight-forward updates.

3) IEEE-C37.90.2 Standard for Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers

This radiated RF immunity document has been reviewed and I have submitted text to address its shortcomings. The test setup diagram is incorrect, the frequency range has been increased but the levels are same/similar. We will discuss my submission in Garden Grove next week. Progress has been slow.

4) IEEE-C37.90.3 IEEE Standard Electrostatic Discharge Tests for Protective Relays

This document needs to harmonize with IEC 61000-4-2, it's self-contradictory and needs to have an informative annex for optional pin testing if the I/O ports are being damaged in use. (USE CASE: a laptop is pushed on a cart and it's I/O cord is plugged into various relay controllers to program them) The use case is supported by the new IEEE-C63.16 Recommended Practice on ESD testing. We hope to meet with the Chair this week to develop a list of things to discuss in Garden Grove. The Chair seems amenable to change, not so much with the members.

5) SEPA-EMI Issues Working Group

The League is continuing to support my work with the former Smart Grid Interoperability Panel (SGIP) originally under NIST, now a working group within SEPA. (Smart Electric Power Alliance) The EMI Issues Working Group did the original work defining the missing tests for utility equipment that became IEEE-1613.1(2013). (when compared to IEC 61850-3) That Standard was the vehicle that brought American utilities into harmonization with the Europeans on specifying reliable communications networking

equipment that could resist interference by demonstrating "immunity" to simulated interference during required type-testing. (harmonized with IEC 61850-3)

Our next product will be a webinar presentation for the rest of SEPA and the General Public to be given January 14. The webinar is the visual presentation of our recent white paper on "Guide for Products Tested for EMC Performance." We're including EMC testing labs from ACIL (American Council of Independent Laboratories) as authors since they are members of SEPA. I expect an audience of maybe 30 people.

6) IEEE-P1897 Recommended Practice for Powerline Noise Mitigation

Mike Gruber is the Chair of this Working Group that's discussing the best practices for utilities to employ for resolving powerline noise complaints. The Vice Chair, Brian Cramer, W9RFI, of Exelon, is also a member of the EMC Committee. Additional EMC Committee members in the Group also include Mr. Ramie, KI6LGY, who serves as its secretary, Mr. Hare, W1RFI, Mr. Beattie, W2TTT, Riley Hollingsworth, K4ZDH, Mr. Boucher, WA1ZBL, Mr. Hranac, N0IVN, and Mr. Carlson, W9XA.

We want consensus with the utility industry and I feel it is attainable. Progress has been slow, as the Working Group insists on reading the document together at each meeting. Relationships are cordial, however. This has been going on for almost three years! I'm assuming we can have text ready to ballot and push out of this Working Group up to our Sponsoring EMC Society Standards Development & Education Committee by the end of 2019.

Mr. Gruber reports that progress continues with p1897, a recommended practice for the resolution of power line gap noise complaints. Although he has now retired as the ARRL EMC Engineer, he is continuing as the Working Group's chairman. Additional EMC Committee members in this group include Messrs. Cramer as Co-chairman, Ramie, Carlson, Hare and Boucher.

This P1897 Working Group is sponsored by the EMC Society. The first formal meeting was held on December 10, 2015 and development on a set of best practices continues with monthly meetings. Mr. Gruber reports that progress has been slower than expected but he hopes that it will be ready for ballot by the end of this year.

RFI-Case Database:

The ARRL HQ staff maintains a database of RFI reports and cases. This is used primarily as a case-management tool for the several hundred RFI cases ARRL handles every year, but the information the Lab staff are gathering about types of interference cases, involved equipment and frequencies will provide a wide range of reporting capability. Here are some statistics from the database for the first half of 2018 and compared to the previous six years:

Category of Case Reported to ARRL Lab/EMC Engineer	2012	2013	2014	2015	2016	2017	2018
BPL	0	0	0	0	0	0	0
Unknown Unintentional Radiators	66	68	81	49	70	73	56
CABLE TV	3	4	4	4	2	2	3
Satellite TV		2	3	1	0	2	0
Computing Devices and Modems	3	5	6	8	3	12	5
Power Line Noise	53	52	51	43	47	44	47
Plasma TV Receivers	5	3	5	1	3	1	1
Other Broadcast Receivers	4	4	4	0	1	1	1
Other Receivers	1	1	4	1	6	5	0
Other Transmitters	2	2	4	3	3	2	13
Broadcast Transmitters	6	6	2	5	1	3	3
Lighting Devices	4	10	15	7	19	6	8
Confirmed & Suspect Grow Lights[1]	---	2	16	6	12	11	10
Fence Systems	0	3	3	0	2	0	2
Battery Chargers / Power Supplies	3	4	5	7	9	6	1
Wheelchair	0	0	0	0	0	0	0
Water Pump Systems	1	2	2	0	0	1	1
HVAC Systems	3	10	6	5	12	6	3
Alarm Systems including detectors	4	2	4	2	3	4	2
Other Appliances	7	7	4	3	10	7	5
GFIC / AFCI	5	7	25	6	5	6	6
AUTOMOBILE Systems	2	7	1	1	3	5	1
Manufacturing and Retail Generated Noise	0	1	2	0	0	0	0
AT&T U-Verse Systems	8	3	4	6	1	2	0
PV Systems	---	2	1	3	10	24	10
Doorbell Transformers	---	2	3	0	2	2	1
Other	36	16	16	15	30	16	12

It is important to note that power line noise consistently remains as one of the most reported and problematic RFI problem reported to the ARRL Lab.

[1] It can be difficult to confirm a Grow Light. As a result, a number of other grow lights may appear as Unknown Sources. Based on their signatures, a number of Unknown Sources are most likely Grow Lights but remain unconfirmed.

ARRL RFI Forums:

The two RFI forums remain ongoing in the ARRL forums pages. These forums provide self-help and discussion for members. They are monitored and moderated by HQ Lab staff and other volunteers. The pages are:

- RFI - Questions and Answers
  - RFI questions and are answered by other members and RFI experts. Members can post questions and read answers about solutions to an RFI problem they are having. The link is: www.arrl.org/forum/categories/view/20

- RFI - General Discussion
  - This forum is a place to discuss technical issues associated with RFI and Amateur Radio. The link is: www.arrl.org/forum/categories/view/21ssion

Committees:

ARRL continues to be represented on professional EMC committees. Messrs. Hare and Carlson continue to represent the interests of Amateur Radio on the ANSI ASC C63® EMC committee. The C63® committee is working on developing industry standards for immunity, emissions and testing of electronic devices. ARRL serves as a resource to the committee to protect the interests of Amateur Radio.

Mr. Hare is the Primary ARRL C63® representative; Mr. Carlson is the Alternate. Mr. Hare serves as the Chair of Subcommittee 5, Immunity. Mr. Hare also serves on Working Groups developing standards for the measurement of LF and HF wireless power-transfer devices, lighting devices and a Working Group writing recommended procedures to test various forms of Industrial, Scientific and Medical devices.

Mr. Ramie serves as the C63® Secretary and as a member of Subcommittee 5. Subcommittee 1 continues to work on a variety of EMC projects, primarily related to test site standardization. Subcommittee 5 deals with immunity and immunity measurement issues. Subcommittee 8 deals with various types of medical equipment. The multiple ARRL EMC Committee representation on C63 watches immunity and testing developments.

Mr. Hare also serves on the IEEE EMC Society Standards Development and Education Committee (SDECom). SDECom serves as the EMC Society standards board, overseeing the development of all IEEE EMC Standards. He was also re-elected to serve a second two-year term, starting January 1, 2019, as the IEEE EMC Society Vice President of Standards.

Related to committee work, Mr. Hare also maintains informal contact with a number of industry groups, including HomePlug, Society of Cable Telecommunications Engineers, Society of Automotive Engineers and the Electric Power Research Institute, as a few examples.

A list of the planned, recent and ongoing EMC activities at the ARRL Laboratory includes:

- Continue to identify and test devices that operate above the FCC limits, including lighting devices.
- Develop standardized methods of locating RFI sources of harmful interference to Amateur Radio stations. Work with other Industry Groups to develop methods of best practices for location sources such as lighting controls, motor controls and power line noise.
- Test a number of devices that belong to staff and/or local hams that have caused instances of harmful interference.

Mr. Gruber continues as Chairman of a Working Group to develop a Recommended Practice for Location of Power Line Gap Noise. Additional EMC Committee members in this group include Messrs. Cramer as Co-chairman, Ramie, Carlson, Hare and Boucher. This P1897 Working Group is sponsored by the EMC Society. The first formal meeting was held on December 10, 2015 and development on a set of best practices continues with monthly meetings.

The WPT-EV Wireless Power Transmission – Electric Vehicle:

The most recent challenge to Amateur Radio spectrum is from potential interference from WPT-EV (Wireless Power Transmission – Electric Vehicles). Appendix #1 shows the block diagram of one such system under development. This rapidly developing threat had been understood to be a large potential issue for the 2019 World Radiocommunications Conference ("WRC-19"). Planning within the IARU Committees had started work on gathering background information about WPT-EV and the potential for harmful interference to the Amateur Radio Service starting approximately at the beginning of 2018. On September 2, 2018 the FCC released a Notice, Report Number 3103 with a call for comments to a Petition for Rulemaking that had been filed jointly by BMW of North America LLC, Ford Motor Company, Nissan North America Inc. and Toyota Motor North America Inc. The ARRL has filed Comments about the proposed field strength limits that would allow high-power wireless charging technologies for electric vehicles that would operate in the 79-90 kHz band. A copy of the ARRL Comment Filing appears as Appendix #2 to this report. What remains quite disconcerting is that the major vehicle manufacturers have begun to lay the regulatory ground-work for WPT-EV prior to WRC-19, and it is being done prior to the publication of the results of any field strength measurement results. A very good pdf online describing the details of certain WPT-EV systems under development by Momentum Dynamics Corporation are available for viewing https://www.psma.com/sites/default/files/uploads/tech-forums-transportation-power-electronics/presentations/is112-wireless-power-transfer-developers-guide.pdf .

While the subject band of frequencies (79-90 kHz) is not directly used by the Amateur Radio Service, the potential for harmful interference remains significant. The ARRL Laboratory and the ARRL EMC Committee has not been able to gain access to any prototype or experimental WPT-EV system for actual field strength measurements.

The limit stated in the NPRM for WPT-EV emissions in the band 79-90 kHz is stated as 74.4 dBuA (dB microAmp) per meter at a distance of 10 meters. An equivalent term for this level of field strength (disregarding the near-field effects) for such a system could be stated as 2 Volt per meter. For a complete discussion of how this proposal compares with existing FCC Part-15 and Part-18 field strength limits please refer to Appendix #3 of this report.

The largest concern is that of harmonics and noise related to a high-power system where those emissions fall onto Amateur Radio spectrum. There is no doubt that there will be harmonics and noise arising from the use of such devices but the ARRL Lab has not been able to make field strength measurements. Of great concern is the fact that WPT-EV has a great potential for harm given that coupling between the charging power source primary and the vehicle's receiving secondary will form an imperfect coupling system, and that mis-alignment between the two could provide for the potential for saturated inductors and power coupling to material other than the target of intended coil on the vehicle. One of the systems that has been described to Mr. Carlson performs an interface between the charging base and vehicle by a separate wireless communications link but that the frequency of the power transmission is swept within the power transfer frequency band to identify the frequency of best power transfer. The potential is strong that each of these systems might continue to sweep the 70 to 90 kHz band along with the attendant harmonic and vestigial switching noise at higher frequencies.

The Committee continues to work to gain access to these systems for actual field strength measurements while the ARRL FCC Counsel continues to monitor the related regulatory issues.

The Future of EMC and Amateur Radio:

Interference to hams appears to be the present major work of the committee. Although immunity problems still do occur, this is being addressed at the national and international standards level. RFI from unlicensed devices poses a major real threat to Amateur Radio at this time. This will continue to require significant Committee and ARRL staff attention. To the extent possible with existing staff, or with additional resources, the ARRL should increase its contact with standards organization, industry groups and individual companies, and continue to work on all aspects of RFI problems and solutions.

ARRL's information about RFI can be read at:
www.arrl.org/radio-frequency-interference-rfi.

I am pleased to welcome Mr. Paul Cianciolo, W1VLF, the ARRL Laboratory EMC Engineer, and Dr. Gregory Lapin, N9GL, Chairman of the ARRL RF Safety Committee to the ARRL EMC Committee.

As a note of personal thanks, I would like to recognize Mr. Hare, W1RFI; Mr. Ramie, KI6LGY; Mr. Gruber, W1MG and. Mr. Paul Cianciolo, W1VLF, for their contribution of material for this report. I would also like to thank all of the EMC Committee members for their ongoing service to the ARRL and the Amateur Radio community.

Respectfully Submitted,

Kermit A Carlson W9XA
ARRL EMC Committee Chairman
Director Central Division

List of Appendices