Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
CARRIER CURRENT SYSTEMS INCLUDING BROADBAND OVER POWER LINE SYSTEMS	)	**ET Docket No. 03-104**
	)	
AMENDMENT OF PART 15 REGARDING NEW REQUIREMENTS AND MEASUREMENT GUIDELINES FOR ACCESS BROADBAND OVER POWER LINE SYSTEMS	)	**ET Docket No. 04-37**

To: The Commission

COMMENTS OF ARRL, THE NATIONAL ASSOCIATION FOR AMATEUR RADIO

ARRL, the National Association for Amateur Radio, also known as the American Radio Relay League, Incorporated (ARRL), by counsel, hereby respectfully submits its comments in response to the *Notice of Proposed Rule Making* (the Notice), FCC 04-29, released February 23, 2004, 69 Fed. Reg.12612 *et seq.* The Notice proposes to amend Part 15 of the Commission's rules governing unlicensed radio frequency (RF) devices to adopt new requirements and measurement guidelines for carrier current systems that provide access to broadband services using electric utilities' power lines, known as Broadband Power Line (BPL) technology. These comments are timely filed. For its comments, ARRL states as follows.

I. Introduction

1. At the outset, ARRL is constrained to suggest that this proceeding is ill-timed and constitutes a blind rush to judgment, for no apparent reason other than a consuming effort to facilitate additional competition in broadband delivery mechanisms. There is

nothing wrong with that goal conceptually. No comments will be filed in this proceeding suggesting that the Commission delay access to broadband service.[1] However, not every technology that might possibly offer a mechanism for competitive broadband access, merely by virtue of that capability, should be authorized by the Commission. The Commission does not have to have proof that a technology is assured, or even likely, of success in the marketplace before proceeding with it on a regulatory basis. It is affirmatively obligated, however, to insure that a potential technology's drawbacks (in terms of compatibility with existing services which themselves provide strong, often essential, public interest benefits) do not outweigh the perceived competitive benefit of the technology under consideration. With respect to BPL, the Commission is proceeding headlong toward authorizing a technology which, even in limited test deployment, has been shown to create significant, harmful interference to fixed and mobile Amateur Radio stations near overhead power lines. This interference, in many cases, has proven not to be subject to resolution.

2. BPL, in frequency bands between 1.7 and 80 MHz, can at this point, only be considered a mistake, purely and simply stated, and the Commission should not authorize it without substantial further research. That the Part 15 regulations now in place, without more, would not proscribe BPL operation in that frequency range is not relevant. The question for resolution is whether access BPL should be permitted at all, and if at all, what regulations ought to exist regarding these distributive systems. ARRL has shown in the comments and reply comments filed in Docket 03-104 that BPL has substantial interference potential throughout entire communities due to the distributive nature of the

[1] Let there be no mistake: ARRL is supportive of the Commission's effort to permit additional competition in the offering of broadband services to the American home and to bring broadband internet service to rural and underserved areas. Wireless broadband and fiber distribution offer excellent competitive systems.

power line radiation of signals at high frequency (HF) and in the low very high frequency (VHF) bands. There were more than 5,000 comments filed in Docket 03-104 by radio amateurs and other users of those bands which reflect their understanding of the serious radiated interference problems inherent in use of unshielded power lines elevated above ground level for conducting relatively strong RF signals. The technical exhibits filed by ARRL conclusively established that there is a significant interference potential from access BPL systems to Amateur Radio operation throughout the Amateur HF allocations.[2] There have been at least 27 interference complaints filed to date with the Commission by radio amateurs due to the operation of access BPL systems at test locations. Some of these interference problems have persisted notwithstanding the good faith efforts of some BPL service providers to resolve the problems. In other cases, the complaints are simply ignored. None has been adjudicated by the Commission, as far as ARRL can tell.[3]

3. Notwithstanding all of the above, the Commission seems unconvinced that the interference potential of BPL is prohibitively high. Commissioner Adelstein's statement accompanying the Notice in this proceeding states, in part, that "[w]hile we must be mindful of harmful interference, we cannot let unsupported claims stand in the way of such an innovation as BPL systems." Which claims of interference are unsupported? Is

[2] The United States is obligated by international treaty to be protective of the HF bands. The ITU Radio Regulations, at RR 4.11, states: "Member states recognize that among frequencies which have long-distance propagation characteristics, those in the bands between 5 MHz and 30 MHz are particularly useful for long-distance communications; they agree to make every possible effort to reserve these bands for such communications. Whenever frequencies in these bands are used for short-or medium-distance communications, the minimum power necessary shall be employed."

[3] Commission staff in the Enforcement Bureau have indicated to ARRL that all complaints about BPL interference are being forwarded to Office of Engineering and Technology staff. This is not the usual procedure for handling complaints. Nor is it clear what, if anything, OET is doing with these complaints once received. Meanwhile, since these complaints are pending and unadjudicated, the BPL providers are taking the position that there is "no" interference, or no "documented" interference from the test sites, and that therefore there is not an interference problem.

this to be the Commission's response to clearly stated technical interference calculations and measurements? What type of interference showing is necessary in order for the Commission to even acknowledge it?

4. Indeed, in this proceeding, all indications are that the Commission simply does not want to hear the bad news, only the good, about BPL. The Chairman has self-described himself as a "cheerleader" for the technology. A nominal extension of time request, filed by ARRL for the sole purpose of allowing a brief opportunity to review and comment in this proceeding on the long-awaited, two-volume NTIA BPL interference study, which was released as late as April 27, 2004, has been denied.[4] This has had the effect of depriving virtually all interested parties of the opportunity to evaluate that report and to incorporate that review in comments in this proceeding. A review of the Notice in this proceeding reveals absolutely no technical analysis of the compatibility between BPL and licensed radio systems, and the conclusions in the notice that any interference to licensed radio services will be minimal is completely unsupported in the Notice. There are few, if any, reports filed by experimental authorization holders with respect to the successes or failures of the experimental operations conducted so far. ARRL's experience with those facilities has been varied, and in the worst cases, the interference throughout entire communities has been overwhelming. The response of the BPL providers in those locations has been to attempt to define in a manner which suits them what constitutes "harmful" interference. It is understandable that BPL providers will not wish to concede

[4] See, the *Order Denying Extension of Time*, DA 04-1175, released April 30, 2004. The Order indicates that any parties wishing to comment on the NTIA study may do so in reply comments. The Commission's rules, however, make it clear that this is not the purpose of a reply comment period. Rather, the purpose is to permit a response to comments already filed in the proceeding. See 47 C.F.R. 1.415(c). The Commission should therefore offer, after the reply comment period closes, an opportunity for all interested parties to reply to reply comments which raise for the first time new matter regarding the NTIA study or otherwise.

the interference potential, as that will drive away potential investors. Other BPL advocates have, throughout the inquiry portion of the proceeding, simply denied that there is any interference issue at all. The Commission, on the other hand, is obligated to make its evaluation of BPL interference potential on a more even-handed basis. To date, ARRL has seen no evidence that the Commission is prepared to conduct an objective evaluation of this technology.

5. Notwithstanding the preconceptions by the Commissioners and OET staff that appear to have irreversibly tainted this proceeding, the Commission's proposals in the Notice are not wholly without merit. There are interference mitigation techniques proposed that could have some after-the-fact benefit in interference reduction in some instances. As will be discussed, however, these are inappropriate as a means of authorizing a service that has acknowledged interference potential to licensed radio services. They are also insufficient as stated to address interference to mobile and other licensed radio operations. The Commission's proposal to utilize current Part 15 radiated emission levels in Sections 15.109 and 15.209 of the current regulations, created to deal with point-source unlicensed devices, is inappropriate for distributive systems such as BPL. The level of permitted radiated emissions must be far lower in order to protect against interference to licensed, and especially mobile, radio operations in the 1.7-80 MHz bands.

II. The Fundamental Precepts Underlying Unlicensed Device Regulation are Abandoned in the Notice Proposal

6. In the Notice, at paragraph 31, the Commission states as follows:

> We recognize the significant concerns of existing radio users regarding the potential for harmful interference from Access BPL operations. After careful consideration, however, we believe that these interference concerns can be adequately addressed. We believe that Access BPL systems can operate successfully under the non-interference requirements of the Part 15 rules. Under these rules, operators of Access BPL systems will be responsible for eliminating any harmful interference that may occur (citing 47 C.F.R. § 15.5). Furthermore, we believe that the current Part 15 emission limits for carrier current systems in conjunction with certain additional requirements specific to Access BPL operations will be adequate to ensure that existing radio operations are protected against harmful interference from such operations.

There is no proffered technical justification for any of the foregoing conclusions, and it remains a mystery why the Commission believes that "Access BPL systems can operate successfully under the non-interference requirements of the Part 15 rules". There are no test results cited that give rise to that assumption. The level of interference complaints from licensed radio amateurs concerning the very few test sites certainly indicates the contrary. And the experience of other countries with BPL would suggest much stronger caution than has been exhibited by the Commission to date. ARRL will demonstrate hereinbelow that the Commission's basic conclusions are in fact incorrect. At the outset, however, it must be noted that the model for Part 15 regulation of BPL systems is inadequate, and the conceptual framework for Part 15 is abandoned by the Notice proposals.

7. Acknowledging interference concerns about BPL generally, the Notice proposes to adopt interference mitigation obligations, which would in general obligate BPL providers to take after-the-fact actions to remedy interference once experienced and reported by a Commission licensee.[5] The Part 15 rules were developed, however, upon

[5] Specifically, the Notice proposes to require that Access BPL devices: (1) deploy adaptive interference mitigation techniques (with unspecified characteristics); (2) maintain a database of installation locations

the fundamental premise, and on the condition, that interference is to be avoided *ab initio*, not remedied *post hoc*. Were it otherwise, the Commission would have no statutory jurisdiction to permit unlicensed operation of devices or systems. 47 U.S.C. § 301. The Commission relies in the Notice on 47 C.F.R. § 15.5, which generally obligates an operator of a Part 15 device or system to avoid harmful interference to any authorized radio service or to cease operation. This however is not sufficient. *The principal obligation of the Commission in permitting unlicensed devices or systems is to establish a radiated emission level that is sufficiently low that by their operation they will predictably not interfere with licensed radio services*. The Section 15.5 non-interference requirement is a catch-all safeguard to cover the exceptional circumstances where interference occurs notwithstanding the prior determination and specification of the appropriate radiated emission level for such devices. In *Restricted Radiation Devices*, 13 RR 1543 (1956) the Commission held that:

> Part 15 is based on the rationale that if radiation can be kept within certain fixed limitations, a general assumption can be made that such operations will normally not cause interference to interstate communications or otherwise will have interstate effects bringing such operations within the purview of those which must be licensed under Section 301 of the Communications Act. Accordingly, it is the Commission's position that these operations, as long as they do not exceed certain radiation limitations and do not in particular situations cause actual interference, may lawfully be carried on without a license.[6]

---

and technical information (without specifying to whom the database would be accessible); and (3) to adopt specific measurement guidelines for both Access BPL and other carrrer current systems. See Paragraph 31 of the Notice and the Appendix B

[6] The assumption at the time was that Section 301 of the Communications Act of 1934, as amended, only applied to interstate communications. Such is not the case, and it has been clarified long since that Section 301 applies to both intrastate and interstate communications. See, *Pub. L. 97-259, the Communications Amendments Act of 1982*, H.R. Conf. Rep. No 97-765 at 31-32 (1982); reprinted at 1982 U.S.C.C.A.N. 2261, 2275-76. Section 301 of the Communications Act of 1934 states, in relevant part, that:

Id., at 1544.

Shortly thereafter, in *Low Power Communication Devices,* 13 RR 1546e (1957), the Commission noted that the establishment of radiated emission levels sufficiently low to prevent instances of interference to licensed services and the prevention of interference (rather than the mitigation of it after the fact) was the *sine qua non* of authorizing unlicensed RF devices:

> The Commission recognizes that in permitting operation without an individual license, the user must be required to take precautionary measures in order to minimize the likelihood of interference to the authorized radio services. Such precautions, in fact, constitute the foundation for the regulation of restricted radiation devices.
>
> *****
>
> These comments [of] AT&T are based upon a misunderstanding of the legal framework of Part 15 of the Commission's Rules. For their suggestions of treating the maximum radiation limits as norms and requiring a cooperative program of interference elimination between the owner of an interfering low power device and an interfered with licensed service, while appropriate for consideration in adopting rules for licensed services cannot, irrespective of their merits, be fitted into the framework of Part 15 of the rules, which relate to the conditions under which no license will be required under Section 301 for the operation of radio transmitting devices. The fixed maxima of radiation for the various devices are the limits of radiation at which they can generally be expected to operate without becoming devices which by their interference potentialities affect interstate and foreign commerce. The additional requirement that they do not cause interference is in recognition of the fact that even at these extremely low radiation limits they will in some special circumstances cause interference and thus their continued unlicensed operation would be illegal under Section 301 (footnote omitted). Consequently, short of adopting a licensing scheme of a type which would clearly be infeasible and much more burdensome on the public, we must adhere to the principle expressed throughout this part of the rules of

---

> No person shall use or operate *any apparatus* for the transmission of energy or communications or signals by radio…except in accordance with this Act *and with a license* in that behalf granted under the provisions of the Act.[6]

By enacting Section 301, Congress prohibited wireless transmissions without a license. The only (very limited) exceptions to this are set forth in Section 307 of the Communications Act of 1934, as amended, and none of those pertain to unlicensed devices generally.

> determining fixed radiation limits and superimposing thereon a non-interference requirement.
>
> *Id.,* at 1546g-1546h.

8. Given the foregoing, three conclusions are apparent: (1) The Commission's fundamental obligation in permitting unlicensed devices and systems is that they not be permitted to radiate RF energy in sufficient amounts to cause interference; (2) The Section 15.5 non-interference condition is an overlay regulation, and not sufficient to justify the authorization of unlicensed devices with significant radiated interference potential; and (3) The entire regulatory framework is based on the prevention of interference at the outset, rather than mitigation of interference later. Licensed radio services are entitled to interference protection. The Notice proposal, however, stands these precepts on their ear.

9. The Part 15 radiated emission limits in Sections 15.109 and 15.209 were never designed for distributive radiating systems. They were designed, rather, to address the interference potential of point source radiators: individual devices operating at single locations. The limits have to be reexamined where the system architecture is a line source radiator, which in matrix form (as overhead power lines are in neighborhoods) creates a situation in which the unshielded power lines act as efficient radiators throughout those neighborhoods.[7] The Notice proposes to apply standards developed to prevent interference from one type of unlicensed device. They were not intended to apply to BPL systems, and as will be shown below, the standard is inapplicable. Section 15.109 and Section 15.209 radiated emission limits are too high to protect nearby Amateur Radio stations against interference. The Commission offers no justification whatsoever for

[7] The Notice acknowledges this to some extent.

applying these inapplicable standards to Access BPL, and in fact has no idea whether the standard is sufficient to avoid interference to licensed services generally. A cursory glance at the extraordinarily voluminous NTIA Report [8] released April 27, 2004 indicates that at current Part 15 levels, the interference contour of Access BPL systems to land vehicle, boat, and fixed stations receiving moderate to strong desired radio signals in the frequency range 1.7-80 MHz is likely in areas extending to 30 meters, 55 meters and 230 meters respectively. Where the desired signal strength is low to moderate (as is the case with Amateur HF communications), the interference contours extend at the classes of receivers above at distances extending to 75 meters, 100 meters and 460 meters from the power lines.[9] Further, interference to aircraft reception of moderate to strong desired radio signals is likely to occur at heights up to 6 km altitude within 12 km of the center of the BPL deployment. [10] A reading of this conclusion would lead any reasonable person to conclude that these interference contours are far, far too large.

10. Second, the Commission relies heavily on Section 15.5 of the Rules, which conditions unlicensed device operation on non-interference. As explained above, this is not sufficient alone in any unlicensed device context. In the case of residential broadband service, it is especially inadequate. First of all, BPL providers at test sites are taking the position that some interference that precludes Amateur Radio communications on some frequencies, or frequency bands, but not all, does not constitute "harmful interference". This is predictable, given the typical response of power utilities to interference complaints from radio amateurs about radio noise emanating from power lines at the

[8] See, *Potential Interference from Broadband over Power Line (BPL) Systems to Federal Government Radiocommunications at 1.7-80 MHz*, NTIA Technical Report 04-413 (Phase 1 Study) released April 27, 2004.
[9] *Id.*, Executive Summary, at p. vi.
[10] *Id.*

present time. That response is spotty, at best, as Commission Enforcement Bureau records will show. As a practical matter, Section 15.5 provides no relief to the licensed radio amateur from interference from Part 15 devices and systems generally. The interference resolution involves difficult negotiations with entities which are either unaware of their obligations under Commission regulations, or are simply uncaring. Neither does the Commission have the resources to address the myriad of interference problems from Part 15 devices and systems. Finally, the priority accorded complaints from Amateurs of interference to their Amateur Radio stations from unlicensed devices is extremely low. For these practical reasons, as well as for the legal reasons cited above, reliance on Section 15.5 by the Commission as a basis for authorizing BPL systems is misplaced.

11. The proposed mitigation techniques set forth in the Notice, addressed in detail below, are an implicit acknowledgement that Access BPL systems have significant interference potential to licensed services at the operating parameters proposed. This is backward. The operating parameters must be set such that interference will not occur to licensed services. The invocation of those mitigation techniques places the burden of interference resolution on the licensed radio service. This burden is precisely backward: the basis for authorizing unlicensed devices, and the obligation of the Commission is to establish operating parameters such that licensed services will not have to utilize mitigation techniques. Further, the obligation of the user of a Part 15 device or system, is to avoid interference in the first place, not to react to predictable interference once it is caused and communications of licensed services are already disrupted.

12. The Commission has in this instance allowed vague policy considerations to overshadow its fundamental obligation to configure its rules to prevent interference. At paragraph 33 of the Notice, the Commission states:

> While we agree that there is some potential for Access BPL to cause harmful interference to radio services, we also tentatively conclude that the likelihood of such harmful interference is low under the current limits and that where such interference does occur, there are remedies that the Access BPL operator can employ to eliminate such interference. On balance, we believe that the benefits of Access BPL for bringing broadband services to the public are sufficiently important and significant as to outweigh the potential for increased (sic) harmful interference that may arise.
>
> Notice, at ¶ 33.

The basis for the Commission's "tentative conclusion" that the likelihood of interference is "low" under the (inapplicable) current limits is unexplained, and it is suggested that there is no basis at all for the tentative conclusion. The record in Docket 03-104 indicates precisely the opposite. Worst of all, however, is the Commission's willingness to "balance" the (presumed) "benefits" of BPL, an unproven technology to say the least, against potential harmful interference to licensed services. *The Commission has no statutory jurisdiction to apply such a balancing test.* Its obligation is to avoid harmful interference from unlicensed systems to allocated, licensed radio services.

III. Access BPL Systems Have an Unacceptably High Interference Potential And Should Not Be Authorized at Current Part 15 Radiated Emission Levels

13. At paragraph 35 of the Notice, the Commission acknowledges that Amateur Radio presents a "difficult challenge" in the deployment of access BPL, at least, it says, in cases where amateurs use high gain outdoor antennas located near power lines. At this point, apparently desperate for a means of sweeping the obvious incompatibility between

Amateur Radio operation and access BPL under the rug, the Notice actually attempts to bootstrap existing harmful interference from power lines into a justification for allowing interfering BPL signals. It states:

> We note that ARRL acknowledges that noise from power lines, absent any Access BPL signals, already presents a significant problem for amateur communications. We therefore would expect that, in practice, many amateurs already orient their antennas to minimize the reception of emissions from nearby electric power lines.
>
> Notice, at ¶ 35.

This paragraph was written by someone who obviously has no understanding of Amateur Radio communications at all. Furthermore, it is frankly an outrage that the Commission would (1) acknowledge that its Part 15 regulations are a complete failure in the context of power lines; (2) accept the fact that power utilities are typically unresponsive to their unconditional regulatory obligation to avoid causing harmful interference and unwilling even to remedy it after the fact; and (3) use that unlawful interference, and the inherent unenforceability of its Part 15 regulations, as factors to attempt to justify the additional (and obviously much more widespread) interference that access BPL would add to the situation. Nor can radio amateurs simply "orient their antennas to minimize the reception of emissions from electric power lines." There is no way to do that in neighborhoods with overhead power lines interlaced throughout the neighborhoods. Amateur Radio antennas for the high frequency bands are most often fixed wire or vertical antennas, and are not subject to being "oriented" in a particular configuration. *And they shouldn't have to be*.

14. Related to this thoughtless attempt at justifying BPL is the suggestion at paragraph 39, which suggests that BPL providers would, due to the significant investment in the deployment of the service, and due to the Section 15.5 non-interference condition,

have a “strong incentive to use the utmost caution in installing their systems to avoid harmful interference and ensure uninterrupted service to their customers.” The strong incentive, in fact, would be to stonewall, as the BPL advocates have done thus far, and to simply deny that there is any interference potential at all from BPL systems. When confronted with the inevitable interference complaints with respect to deployed systems, they would have a “strong incentive” to merely write off the complaints as “unsupported”, as Commissioner Adelstein has apparently done, or else to deny that the interference is “harmful” and therefore the BPL system has no obligation to remedy it. Given the dismal record of power utilities in resolving interference complaints to date, there is every reason to believe that this will happen. Given the record of Commission enforcement of its Part 15 non-interference regulations and the inherent difficulty of *post-hoc* Part 15 interference resolution, there is every reason to believe that the problem will be ignored. The 45 or more interference complaints regarding BPL test sites that have been filed with the Commission and which remain under wraps in the Office of Engineering and Technology are an ominous sign to the Amateur Radio Service, and one that we cannot allow the Commission to avoid any longer. The history of compliance on the part of power utilities is dismal, and there is no reason whatsoever to believe that it will improve with the addition of a spectral pollutant such as BPL.

15. ARRL has recently commissioned additional technical studies using independent consulting engineering firms and experienced individuals to evaluate by measurements at BPL test sites and by calculations the interference potential of BPL systems. The results of these studies are attached. **Exhibit A** is a test report entitled, "BPL Trial Systems Electromagnetic Emission Tests," prepared by Metavox, Inc., of

Dulles, Virginia under contract to ARRL. The primary purpose of the contract was to measure field strengths of radiated emissions from BPL systems. Given the measured field strengths and an agreed-upon method of interpolating and extrapolating them, it is possible to determine the levels at amateur stations having different distances from the BPL system. The principal findings of these tests are as follows:

> 1) At the site called "Emmaus-1b" in Emmaus, Pennsylvania, measurements showed that the BPL system exceeded FCC Part 15 limits for frequencies 3.5-20 MHz by amounts up to 21.4 dB, the highest level being at 8.01 MHz.
>
> 2) The site "Emmaus-2" was chosen to establish a background level for comparison with the Emmaus-1b measurements (i.e., without BPL signals but with a similar 3-phase power distribution system). Measurements were made from 1.71 through 21.5 MHz and no BPL signals were observed. Field strengths at this site were more than 20 dB below those at the Emmaus-1b BPL site. At 8.01 MHz the background level was 36 dB below the BPL signal level at Emmaus-1b.
>
> 3) Tests at the site "Whitehall-1a" in Whitehall Township, PA could not be made at the standard 30-meter measurement distance because of private property boundaries. However, the BPL system (different technology than that used in Emmaus) was roughly in compliance with Part 15 limits but the signals were individual carriers spaced less than 1 kHz apart such that they would have interfered seriously with reception of Amateur Radio signals.
>
> 4) At the site named "Emmaus-1a," measurements were taken to provide experience with extrapolation methods. There was no significant difference between measurements at 17.6 meters and 30 meters from the BPL lines.[11] Unpredictable events occur in the near field. This demonstrates the errors that could occur by blind application of the 40-dB decay standard. It would be expected that signals would rise as one moves closer to the source, but sometimes the opposite occurs, resulting from

[11] ARRL challenges the Commission's assumptions regarding signal interpolation and extrapolation. It is recognized that there is disagreement as to whether 40-dB or 20-dB signal decay per decade distance is appropriate. Part 15 specifies 40 dB, but this number appears to be predicated on radiation from a point source (as from a device under test), whereas a BPL system is an extended source. ARRL's laboratory staff is of the view that 20 dB is the appropriate standard. The matter is significant because the 40-dB decay standard would indicate that the BPL field intensity falls off more rapidly than ARRL's tests indicate. Also, it is not always possible for measurements to be taken at exactly 30 meters from the source because of physical conditions *in situ*.

summation of the signal phases from numerous points including reflections.

5) At "Manassas-1," measurements indicated that BPL radiated emissions exceeded the FCC Part 15 limit across the range 3.5-14 MHz, the highest point being at 8.75 MHz approximately 5 dB above the limit. This BPL signal would cause serious interference to an amateur station having its antenna 30 meters away from the BPL lines.

16. Attached hereto as **Exhibit B** is a study of compatibility between BPL and Amateur Radio Service stations, conducted under contract with ARRL by Dr. David Cohen, currently with the University of Maryland, and formerly with NTIA. The report includes a recitation of Dr. Cohen's qualifications and experience in this area. Cohen's report is "preliminary" to the extent that he did not have a chance to review the NTIA BPL Study released April 27, 2004 prior to rendering his findings. Therefore, ARRL reserves the right to update this report at a later time in this proceeding.

17. Cohen draws upon a number of documents for his analysis. The noteworthy ones are: Weinmann, F. and Dosert, K., "Modeling of the Far Field Radiation of Widespread Power Line Communication Applications," EMC2003 and Kho, K., "Protection Requirements for Military HF Radio Services. Based on a Generic Sharing Criteria for HF Systems," EMC2002. Briefly summarized, Cohen finds (1) that the Kho model is a credible basis for Part 15 field strength limits; and (2) that the ARRL exhibits (prepared by the ARRL Laboratory) filed with comments in the Notice of Inquiry in this proceeding are essentially consistent with the Kho model. Kho concluded that the German RegTP standard NB 30 level is sufficient to protect radio services. Cohen states that the NB 30 limit at 3 meters distance measured at 5 MHz is 33.85 μV/m, or about 31 dB lower than the FCC limit of 65 μV/m. It is acknowledged that NB 30 slopes

downward with frequency whereas the FCC Part 15 limit is a flat line; 5 MHz was simply chosen as one point for comparison.

18. NB 30 is a German domestic footnote to their frequency allocation table that is widely recognized. NB 30 would be a significant improvement over the Part 15 radiated emission limit and would appear to reduce BPL interference to radio services in general; perhaps low enough to avoid skywave propagation of cumulative BPL signals if widely deployed. NB 30, however, is insufficient to protect the amateur fixed station (or short wave broadcast receiver) within a city block or two of a power line carrying BPL, nor the amateur mobile station. The amateur fixed station might obtain some relief from a diligent BPL provider, required by Part 15 to mitigate interference. The amateur mobile station, however, is completely unprotected by any *post-hoc* mitigation procedure and must rely on the signal level established at a low enough level (or if the BPL provider does not make use of Amateur allocations.

19. A major issue in the analysis of interference from BPL to geographically proximate Amateur Radio stations is the extent to which BPL signals radiate from the power lines. That is, whether or not the systems radiate as point source radiators or as distributive systems, i.e. line source radiators. BPL proponents in the Docket 03-104 Inquiry portion of this proceeding suggest without technical analysis that Access BPL operates as would a point-source radiator. Indeed, the BPL proponents are boxed into this argument, because the Part 15 radiated emission levels are premised on point-source radiators and not distributive systems. The interference characteristics of each are substantially different. To concede that Access BPL is a line-source radiating system would be to concede the inappropriateness of the current Part 15 radiated emission levels.

Anyone familiar with HF antenna systems, including the thousands of licensed radio amateurs who filed comments in that proceeding found the BPL advocates' argument ludicrous. The Notice in this proceeding, without any technical justification, waffled on the issue:

> Although we agree with ARRL that Access BPL on overhead lines is not a traditional point-source emitter, we do not believe that Access BPL devices will cause the power lines to act as countless miles of transmission lines all radiating RF energy along their full length. Rather, the primary source of emissions will be the individual couplers, repeaters and other devices and, to a lesser extent, the power line immediately adjacent thereto.
>
> Notice, at ¶ 36.

20. Precisely why the Commission concluded that the line radiation will somehow suddenly stop is unclear. In any case, the attached **Exhibit C**, prepared by ARRL Chief Technology Officer Paul Rinaldo, addresses this issue. The study, entitled "Proposed Radiated Emission Limits and Extrapolation", concludes that BPL signals on overhead power lines are line source radiators and that they are extremely efficient at HF frequencies.[12] It also concludes that, for compliance purposes, measurements should be made at a single separation distance, such as 10 meters. Finally, the study concludes that extrapolation should be avoided whenever possible, but where needed, an extrapolation factor of 20 dB/decade should be used rather than the Commission's proposed 40 dB/decade.

21. Based on the foregoing studies, it can be concluded that Access BPL, operated at the current Section 15.109 and Section 15.209 field strengths will create substantial

[12] The NTIA BPL Study conclusions initially appear consistent. At Page 9-3 thereof, NTIA concludes, in part, that "modeling results imply that compliance measurements, taken only around a BPL device and at heights below the power lines, may significantly underestimate the peak electric field."

interference to nearby Amateur Radio stations, whether fixed or mobile. The HF spectrum is used heavily, 24 hours each day, every day, by radio amateurs for worldwide, nationwide, regional and even local communications, using extremely weak received signal strengths. The interference to fixed Amateur stations located in residences in normal geographic proximity to overhead power lines will be devastating and will preclude Amateur Radio communications. As discussed below, the mitigation techniques proposed by the Commission are too little, too late to avoid widespread interference. One of the significant recommendations in the NTIA BPL report is to avoid "locally used frequencies". ARRL would recommend that Access BPL be precluded from utilizing any Amateur HF or VHF allocation.

IV. The Proposed Mitigation Provisions are Insufficient

22. The Notice acknowledges at paragraph 1 that it is the Commission's obligation to "protect licensed radio services from any harmful interference that might occur." At paragraph 39, the Commission warns Access BPL providers that operations must cease if harmful interference to licensed services is caused. As discussed above, experience to date with BPL test sites, with power utility companies, and with Commission enforcement involving the Amateur Service and Part 15 devices indicates that these obligations will not be fulfilled as a practical matter. Also as discussed above, *post hoc* interference mitigation techniques improperly place the burden of initiation on the victim licensed radio service, and are inconsistent with the statutory scheme for regulation of radio services in Section 301 of the Communications Act.

23. Taking the mitigation provisions at face value, however, they are vaguely stated in the Rules and therefore of little value. First, the Commission proposes to require Access BPL systems and devices to incorporate capabilities that would allow the operator to modify system performance to mitigate or avoid harmful interference to radio services.[13] These techniques are specified in the Notice only anecdotally, and not in the rules at all. The proposed Section 15.109(f) merely states that "adaptive interference mitigation techniques such as dynamic or remote reduction in power and adjustment in operating frequencies, in order for Access BPL installations to avoid site-specific, localized use (sic) of the same spectrum by licensed services." The proposed rule also requires incorporation of a "shut-down feature" to deactivate units "found" to cause interference. The specific requirements and operating parameters of these systems are unspecified. It is not clear what "mitigate or avoid" means in the context of harmful interference. Mere "mitigation" of harmful interference to an Amateur station is not sufficient, and is not what the Commission stated its obligation to licensed services to be. It is the absolute obligation of the operator of a Part 15 device or system to prevent interference. The rule as stated does not even require interference *resolution*. It only requires some unspecified "mitigation" and the determination of what level of mitigation is sufficient is apparently left to the subjective evaluation of the BPL provider.

24. At what point will the Access BPL system have to shut down after it is "found" to cause interference? The timing of the matter is unstated, and the determination of harmful interference, which is already subject to debate at BPL test sites, is clearly a matter that is not going to be agreed upon. ARRL's concern is that a complaint of

[13] Notice, at ¶ 40.

harmful interference will be resolved with the same alacrity as are complaints of power line noise now. These complaints drag on for months or years, and often require Commission intervention, which is typically unavailable. Only immediate shutdown of Access BPL systems in the event of a complaint of harmful interference from a nearby Amateur Radio operator is a sufficient response, and the proposed rule does not require such. Given the foregoing, the first interference "mitigation" provision is illusory.

25. The Notice indicates that the Commission is familiar with ODFM modulation techniques which facilitate the ability to dynamically select the specific frequencies used to provide service and to avoid use of specific frequencies where operation might result in harmful interference. It is also claimed that PowerWAN states that "notching" of "specific frequency [bands] is technically feasible." It can apparently notch out individual frequencies "on the fly". The Commission asks whether the rules should detail specific requirements for such systems. It also notes that it encourages BPL providers and manufacturers to "work with amateurs" to develop such mitigation requirements.[14] As to these suggestions, ARRL would first note that no dynamic frequency selection configuration of Access BPL systems is going to work because the systems can only respond to signals heard. They will not be sensitive enough to hear the weak signals that a nearby amateur station is attempting to receive in the HF bands. They could only respond to transmitted signals. If the BPL systems are frequency agile, and given that the Notice assumes that Amateur Radio presents a unique interference concern, an obvious step is to require that all Access BPL systems avoid use of any Amateur Radio allocation. The Notice further asks about the cost-effectiveness of BPL interference "mitigation"

[14] *Id.,* ¶ 42.

techniques. ARRL suggests that the cost-effectiveness of interference remedies is not a relevant analysis. Rather, the only relevant inquiry is the effectiveness of various interference resolution techniques. This is not, as discussed above, a "balancing of interests" situation. Unlicensed devices, in order to be authorized, cannot cause interference to licensed, allocated radio services. Regardless of the cost of interference avoidance, it must be mandated by any rules governing these systems, or the systems cannot be permitted to operate at all. The cost, *whatever it is*, must be borne by the provider of the unlicensed service.

26. The Commission's overly aggressive timetable for proceeding with BPL systems has certainly offered no opportunity for BPL manufacturers and providers to "work with amateurs" to develop "appropriate mitigation requirements." If the Commission seriously wishes to encourage such dialog, it is going to have to allow sufficient time to do that. Since BPL test sites are just now being deployed, there is no reason for the accelerated timetable for adoption of the rules proposed in this proceeding. The "rush to judgment" will effectively preclude, not encourage, the development of cooperative interference avoidance and resolution mechanisms. This proceeding should be placed on hold for a year in order to work out appropriate interference avoidance and resolution standards.

27. Finally, the Commission proposes to require a "notification requirement" similar to that for PLC systems.[15] The BPL operator would be required to submit information about its system to an industry operated entity, to ensure that the location of

[15] To be at all useful, the data basemust be kept absolutely up to date, as the time it is most likely to be needed is at the onset of testing of a new BPL system.

Access BPL systems and their operating characteristics are identified if harmful interference occurs and to facilitate interference "mitigation" and avoidance measures. The proposed rule, Section 15.109(g), would merely require that the information be provided to the entity approved by the Commission and by NTIA. There is no disclosure requirement in the rules, and no indication that the database would be available to radio amateurs. It is, therefore, not of any use to the Amateur Service in interference resolution, and certainly could not contribute to interference avoidance. Furthermore, this requirement is completely at variance with the proposal at paragraph 44 to permit BPL equipment to be subject to the verification procedure for equipment authorization, which requires no submission of information to the Commission (or public disclosure after equipment authorization of the operating parameters of the devices) at all. The use of the same model for equipment authorization as is used for all other unintentional radiators is completely unreasonable, given the far more substantial interference potential of Access BPL devices than exists with other Part 15 unintentional radiators.

28. Mitigation techniques, in order to be effective to resolve Amateur Radio interference, would have to incorporate the following parameters. First, there would have to be performance standards for interference resolution. The BPL provider must be able to immediately[16] resolve interference in real time, 24 hours per day, 7 days per week. Immediate, in this context, means that a response must be immediate upon receipt by the BPL provider upon receipt of a complaint from a licensed radio amateur. Second, the

[16] In this instance, "immediately" can only reasonably be defined as meaning "upon receipt of complaint." Once the location of the complainant is established, the interference must be resolved in no greater time than it takes to throw a switch. Minutes or seconds is the appropriate time frame. Interference complaints at BPL test sites presently are taking weeks to resolve, and ultimately, in several instances the interference cannot be or has not been remedied at all.

BPL database called for in the Notice must be available to the public and be kept up to date. Third, because any *post hoc* interference mitigation is impractical in the case of interference to licensed mobile stations, a radiated emission limit sufficient to protect mobile stations in all subject services must be established and enforced (this subject is addressed below). Fourth, BPL systems must be tested for rule compliance by an independent testing source not affiliated with the BPL provider prior to initiation of operation at any location. Fifth, to ensure an informed marketplace, so that consumers can evaluate for themselves the comparative benefits of broadband delivery mechanisms (and because, inevitably, BPL outages and disruption of service will occur due to RF ingress), BPL providers must provide clear notice to customers of the operating conditions of Part 15 systems; that licensed radio services have priority; and that BPL service cannot therefore be guaranteed. Receipt of this notice should be acknowledged in writing as part of any contract for service. Finally, sixth, the Commission must be willing to commit to firm and adequate enforcement of these provisions and there must be substantial penalties for non-compliance. [17] **Appendix A** attached would be an improvement over the Commission's proposed Section 15.109(f) and (g).

V. Proposed Measurement Criteria

29. Attached hereto as **Exhibit D** is a study conducted by ARRL Laboratory Manager Ed Hare, which discusses the Commission's proposed measurement Guidelines

[17] The present standard (base) monetary forfeiture for interference is $7,000 per incident. Exceeding power limits carries a standard forfeiture amount of $5,000 per incident. The failure to make required measurements or conduct required monitoring carries at $2,000 forfeiture, per incident. *Forfeiture Policy Statement*, 12 FCC Rcd. 17087 (1997); *reconsideration denied*, 15 FCC Rcd. 303 (1999). These forfeitures should be assessed in each case, on a timely basis. ARRL expects and insists on even-handed treatment for interference complaints filed by radio amateurs against BPL systems, just as in the case of other types of interference complaints in other radio services.

for Acces BPL systems. The study utilized NEC-4 antenna modeling to answer some of the questions posed. The paper supports most of the proposed test-method recommendations. The modeling results do indicate that some changes to the test method would make them a more reliable predictor of the actual field-strength levels near power lines carrying BPL. The conclusions are summarized as follows:

> (1) Testing should be done at the maximum power settings over the frequency range and data rates.
> (2) Below 30 MHz measurements should be performed with loop antennas in all three axes.
> (3) Electric-field measurements should be made above 30 MHz, at heights from 1 to 4 meters.
> (4) The requirement to test each device is reasonable.
> (5) The standard measurement distance should be 10 meters.
> (6) ARRL agrees with the test methods proposed for in-house BPL and carrier-current devices.

VI. Access BPL Interference to Mobile Stations

30. As discussed above, the Notice proposes to adopt the existing Part 15 radiated emission limitations in the Rules for all BPL systems. This, coupled with the fact that the *post hoc* interference mitigation techniques proposed in the Notice cannot provide any benefit to mobile stations suffering interference, fails to protect mobile stations from BPL interference. As noted above, the NTIA study concluded that a land vehicle receiving low-to-moderate desired signals can be interfered with at distances of 75 meters from the power line carrying BPL. It is apparent that lower permitted field strengths are necessary in order to protect mobile radio stations. Attached hereto as **Exhibit E** is an analysis of Amateur Mobile Station Protection Criteria prepared by ARRL staff. The ultimate conclusion from this study is that, in order to avoid regular, harmful interference to

amateur radio mobile stations at normal distance separations from BPL-carrying power lines, current Part 15 emission levels will cause interference to radio receivers approximately 25 – 35 dB above ambient levels. An acceptable level for radiated emissions from Access BPL systems to protect typical amateur mobile stations is 0 dBμV/m at the antenna measured at 10 meters away from the power line.

VII. Amateur Radio Interference to Access BPL Systems

31. ARRL is in the process of testing the susceptibility of BPL modems to interference from normal Amateur Radio operation. Preliminarily, it has been determined that at normal separation distances between power lines carrying Access BPL and Amateur Radio antennas, transmissions at between 10 and 100 watts transmitter power output will interrupt or preclude BPL data packets. Amateur Radio stations operating at HF and in the 50-54 MHz band are authorized to transmit at up to 1500 watts PEP output power, and at effective radiated power considerably higher than that. Notwithstanding the obligation of Part 15 users and system operators to tolerate any interference received, this is meaningless to broadband subscribers whose access is interrupted or precluded by perfectly lawful and routine Amateur Radio operation in the neighborhood. The Commission cannot authorize Access BPL unless and until the interference susceptibility of such systems is determined.

VIII. Conclusions

32. The Commission's Notice in this proceeding is ill-timed and constitutes a rush to judgment. The Commission should not proceed with rules governing Access BPL until further opportunity to evaluate the interference potential of BPL to licensed services is at

hand. The NTIA interference study, which is directly relevant to this proceeding, has just been released on April 27, 2004, and there has been insufficient time to review and analyze it. NTIA obviously plans further (Phase 2) investigation of the interference issue. The Commission cannot be in such a hurry to deploy BPL as a potentially competitive broadband delivery mechanism that it must sweep under the rug the mounting evidence that BPL is a significant source of interference to licensed radio services and is not in the public interest.

33. It is well understood that the existing Part 15 rules would, without more, permit operation of Access BPL systems under certain circumstances. Therefore, the Notice proposal, to the extent that it acknowledges the substantial interference potential of BPL and proposes some mitigation provisions, would seem to be an improvement over the *status quo*. That is, however, an illusion. The proposed mitigation techniques are not in any sense sufficient as proposed, and in fact seem to be exculpatory with respect to the normal obligation of a Part 15 system operator. The proposed application of existing radiated emission levels to Access BPL systems is inappropriate. Those levels are far too high, and were designed to address the interference potential of point source radiators. It is obvious that Access BPL systems are distributive, line-source radiators and consequently the Commission would have to apply considerably more conservative radiated emission limits than those which apply to normal Part 15 devices. Since no interference mitigation techniques could resolve interference to mobile radio stations, the limit adopted for Access BPL should be sufficiently low as to prevent interference to mobile stations at the outset.

34. ARRL is firmly of the belief that the Notice in this proceeding is inconsistent with the fundamental scheme of regulation for unlicensed devices, and is inconsistent with the statutory authority of the Commission to authorize unlicensed devices in the first place. The obligation of the Commission is to adopt rules which adequately avoid interference to licensed radio services, not to adopt rules that allow interfering devices and systems to interfere if they respond after the fact to "mitigate" (to some unspecified degree) the harmful interference. Nor can the Commission "balance" the harmful interference potential against its presumption of the public benefits of an unproven interference source which might at some point be able to offer a competitive broadband delivery service.

35. ARRL would urge that the Commission not permit Access BPL at this time. If it should proceed with BPL rules, the Commission should preclude any use of Amateur Radio allocations. In any case, radiated emission rules should be adopted which are sufficient to predictably protect mobile radio stations from interference. Finally, the interference resolution mechanisms that are adopted should be real, rather than merely illusory, and they should incorporate all of the elements discussed in paragraph 27 of these Comments.

Therefore, the foregoing considered, ARRL, the National Association for Amateur Radio, respectfully requests that the Commission enact rules for Access

Broadband Over Power Line systems, if at all, in accordance with the foregoing comments, and not otherwise.

Respectfully submitted,

ARRL, THE NATIONAL ASSOCIATION FOR AMATEUR RADIO

225 Main Street
Newington, CT 06111-1494

By: Christopher D. Imlay
Christopher D. Imlay
Its General Counsel

BOOTH, FRERET, IMLAY & TEPPER, P.C.
14356 Cape May Road
Silver Spring, MD 20904-6011
(301) 384-5525

May 3, 2004

APPENDIX A

Section 15.109 is proposed to be amended by adding paragraphs (f) and (g); and re-designating the existing paragraphs (f), (g) and (h) as (h), (i) and (j), to read as follows:

Section 15.109. Radiated Emission Limits.

*****

(f) Access BPL systems shall incorporate adaptive interference resolution techniques sufficient to cause such systems to cease operation within one hour of notification to the system operator by a licensee of the Commission that harmful interference is being caused to that licensed station. The BPL system shall not resume operation (other than for tests of the system with the active involvement of the complaining licensee) within one kilometer of the location of the complainant's station unless and until the harmful interference is resolved. In case of dispute as to the status of interference resolution, the Commission's District Office with jurisdiction over that location shall be consulted by the BPL system operator prior to recommencing operation, with prior notice to the complaining licensee. Access BPL systems shall be inspected by the system operator throughout the system not less frequently than every six (6) months, to insure that radiated emissions from the power lines do not exceed the limits specified in this Part at any point. Should radiated emissions in excess of permitted limits be found, operation of the system must cease in that area until operating parameters are restored within applicable limits.

(g) Entities operating Access BPL systems shall supply to a Federal Communications Commission/National Telecommunications and Information Administration recognized industry operated entity, information on all existing, changes to existing and proposed Access BPL systems for inclusion in a publicly accessible database. Such information, to be provided on a published web site, shall include the installation locations, frequency bands of operation, and type of modulation used.

*****