Before the
Federal Communications Commission
Washington DC 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

REPLY COMMENTS OF CURRENT TECHNOLOGIES, LLC

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TABLE OF CONTENTS

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CURRENT Technologies, LLC, a leading provider of broadband over power line ("BPL") technology, files these reply comments in response to the Request for Further Comment and Further Notice of Proposed Rulemaking ("Notice") in the above-captioned proceeding.[1]

This responds to the Comments of ARRL, the National Association for Amateur Radio (filed Sept. 23, 2009) ("ARRL"). No other timely filed comments addressed the issues identified below.

A. SUMMARY

ARRL tries to widen this very limited remand phase into an overall "zero-based review" of the entire proceeding. But the remand scope is very limited. The Court of Appeals affirmed the Commission on all but two narrow issues. It required only that the Commission disclose and receive comment on certain redacted documents, and re-justify its choice of 40 dB/decade as an extrapolation factor below 30 MHz. No other issues are before the Commission.

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[1] *Access Broadband over Power Line Systems*, Request for Further Comment and Further Notice of Proposed Rulemaking, 24 FCC Rcd 9669 (2009) ("Notice").

The Commission thus should dismiss ARRL's renewed demand for full-time notching of all amateur bands. ARRL sought this same relief at every possible stage of the proceeding. The Commission turned it down every time. In order to justify notching now, ARRL would have to show the newly unredacted materials so completely tilt the balance of the record as to make any other outcome arbitrary and capricious under the Administrative Procedure Act. Nothing in the disclosure comes anywhere close to accomplishing that goal.

Nor does anything in the new material – or elsewhere in the record – disallow the Commission's choice of 40 dB/decade as an extrapolation factor. The Commission need not establish this to be the right value, or even the best one – only that it is reasonable. The Commission's first effort fell short, according to the court, but it has made the showing now.[2] The underlying measurements are difficult, and the results tend to be inconsistent, so that 40 dB/decade may not be the only defensible outcome. But it is certainly within the reasonable range, which is all that the law requires. The alternative option of 30 dB/decade has less support in the record, so for the Commission to change its initial decision to adopt that value would not be rational.

Finally, the Commission is under no obligation to replace its differing extrapolation factors above and below 30 MHz with a sliding scale. ARRL objects that the actual propagation characteristics do not change abruptly at 30 MHz. True; but the task of regulation often amounts to setting fixed numbers notwithstanding variability in the data. This case is no different.

The BPL rules are reasonable in all respects, and should stand.

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[2] Notice at ¶¶ 25-32.

B. ARRL MISUNDERSTANDS THE SCOPE OF THE PRESENT NOTICE.

ARRL seeks to re-open all of the central issues it has contested since the original Notice of Inquiry. It demands what it calls a "zero-based review."[3] Presumably this means throwing out all the Commission's findings over the past 77 months and starting again from scratch.

The actual reach of this phase is far narrower. Things might be different had the Court of Appeals invalidated the BPL rules, as ARRL requested. But it did not. To the contrary, the court rebuffed ARRL's efforts and affirmed the Commission in all but two specific respects: it ordered a review of certain formerly redacted documents,[4] and it asked the Commission to explain why it chose 40 dB/decade as the extrapolation factor below 30 MHz.[5] No other question is open.

The Commission should thus disregard one of ARRL's two basic demands: for mandatory, full-time notching of all amateur allocations.[6] ARRL sought mandatory notching in its first comment on the BPL Notice of Inquiry,[7] and again at the opening of the rulemaking phase.[8] The Commission rejected the idea in the original Report and Order.[9] ARRL tried again

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3 Comments of ARRL at 7.

4 *American Radio Relay League v. FCC*, 524 F.3d 227, 240 (D.C. Cir. 2008).

5 *Id*. at 241.

6 Comments of ARRL at 7. The other demand is for a 20 dB/decade extrapolation factor below 30 MHz. *Id*. Although ARRL connects these with the word "and," we assume it intends them in the alternative. If BPL were excluded from all amateur bands, the choice of extrapolation factor would have no effect on amateur operations.

7 Comments of ARRL in ET Docket No. 03-104 at 10 (filed July 7, 2003).

8 Comments of ARRL in ET Docket Nos. 03-104, 04-37 at 28 (filed May 3, 2004).

in its reconsideration petition.[10] The Commission again refused.[11] In the Court of Appeals, ARRL argued that any interference with amateur radio made the BPL rules unlawful.[12] The court rejected that view.[13] Now ARRL is back yet again, once more insisting the Commission require BPL operators to notch the amateur bands.

The demand has been exhaustively aired and repeatedly rejected. It is far outside the scope of both the court's remand order and the present Notice, and deserves no further consideration.

C. THE FORMERLY REDACTED MATERIALS DO NOT INVALIDATE THE BPL RULES.

ARRL has picked through the newly released documents, no doubt looking for the "smoking gun": incontrovertible evidence that BPL causes harmful interference to amateur radio on a scale that requires rescission of the BPL rules. That evidence does not exist. Instead, all that ARRL can dredge up are bits and pieces of commentary inconsistent with the Commission's ultimate conclusions. These, say ARRL, warrant full-time notching.[14]

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9 *Access Broadband over Power Line Systems*, Report and Order, 19 FCC Rcd 21265 at ¶ 53 (2004) ("R&O").

10 Petition for Reconsideration of ARRL at 16-19 (filed Feb. 7, 2005); Petition for Issuance of Further Notice of Proposed Rule Making and for Amendment of Regulations of ARRL at 4-5, 13, 18-19 (filed Oct. 18, 2005).

11 *Access Broadband over Power Line Systems*, Memorandum Opinion and Order, 21 FCC Rcd 9308 at ¶ 35 (2006).

12 *ARRL v. FCC*, 524 F.3d at 233.

13 The court agreed with the Commission that the BPL rules would suffice to prevent harmful interference. *Id*. at 234-236.

14 Comments of ARRL at 3, 39.

CURRENT disagrees. To justify a notching requirement at this stage, ARRL would have to show that the formerly redacted materials, ***in the context of the entire record***, render any rule without that requirement arbitrary and capricious. ARRL's efforts fall far short.

ARRL does allege that the newly released materials include numerous instances of BPL interfering with amateur radio. But it fails to make three showings needed to justify their consideration.

First, ARRL must establish that an omitted item is of sufficiently high reliability as to merit weight in the proceeding. To take just one example: ARRL cites a newly released PowerPoint presentation that evaluates BPL noise against the noise floors in rural, residential, and business environments.[15] Among other claims, says ARRL, the presentation asserts that residential-area noise floors have ***decreased*** by 10 dB since noise models were adopted.[16] The presentation goes on to conclude that BPL, relative to the residential noise floor, would "likely have a major impact on some amateurs."[17]

One reason the Commission might have declined to consider this presentation in the R&O is the sheer implausibility of its assumptions. The assertion that residential noise floors are headed downward, even as the residential use of electronic gadgetry that causes such noise is sharply up, defies logic and common sense. It is like saying more people are driving on the same roads, yet traffic congestion is somehow reduced. Perhaps the Commission found the presentation to be suspicious on its face, and for that reason quietly set it aside. Merely having a

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15 Comments of ARRL at 38-41.

16 Comments of ARRL at 39.

17 Comments of ARRL at 40-41.

piece of paper in its files does not obligate the Commission to take it seriously, if the senior staff recognizes the document is logically inconsistent on its face. In any event, its inclusion in the overall record does not change the Commission's initial decision.

Second, the Amateur Radio Service is not protected against all interference from BPL, only from "harmful interference."[18] In this context, harmful interference is defined as interference which "seriously degrades, obstructs, or repeatedly interrupts" a licensed service.[19] While ARRL acknowledges this limitation, it does not show that the incidents it points to are severe or persistent enough to qualify as harmful interference.

Some amateur signals are barely receivable, and likely to be impacted even by low levels of interference. On the other hand, those very weak signals tend to go in and out as atmospheric conditions shift, even in the absence of BPL. Blaming problems with their reception on BPL may not be accurate. Conversely, signals strong enough for reliable reception in the absence of BPL are likely to withstand BPL reasonably well, at least enough that any interference may not qualify as harmful interference.

In a filing before the BPL proceeding began, ARRL remarked on the various factors that pose difficulties in finding the point at which unlicensed devices require preventative measures to protect licensed radio services:

> Where, however, is that point? Where is the line to be drawn? In ARRL's view, it is not a fixed, bright-line determination premised on an ERP or EIRP level, or a fixed field strength. The line is dependent in every case on those factors, plus, for example, duty cycle, bandwidth, antenna gain or loss, emission type, deployment area, frequency and the number of

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[18] 47 C.F.R. § 15.5(b).

[19] 47 C.F.R. § 2.1.

> devices to be deployed. ***The Commission is the proper authority to draw the line in each instance*** . . . .[20]

Here, too, drawing the line is a complex judgment call, and the Commission's responsibility. The Commission did it correctly. Nothing in the newly released material says otherwise.

Finally, allegations of BPL interference can be an effective attack against the BPL rules only if the system causing the interference is in compliance with those rules. ARRL states: "[M]any of the BPL deployments tested by ARRL to date have been operating at levels in excess of the Part 15 radiated emission maximum in the HF band."[21] ARRL provides a concrete example: as a primary example of the Commission disregarding redacted data, it points to a study of the Ambient system at Briarcliff Manor.[22] Yet ARRL has published a report alleging noncompliant operation of that same system.[23]

Any system that is noncompliant today points to an enforcement problem the Commission must address. But ARRL cannot both complain that a system is out of compliance with the rules, and also use interference from that same system as evidence that the rules are inadequate.

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[20] Consolidated Reply to Oppositions to Petitions for Reconsideration of ARRL in ET Docket No. 98-156 at 3 (filed June 28, 2002) (emphasis added). The proceeding concerned unlicensed operation in the 24.05-24.25 GHz band. ARRL questioned (as it did here) the Commission's power under Section 301 of the Communications Act to authorize potentially interfering unlicensed devices.

[21] Comments of ARRL at 43 (italics omitted).

[22] Comments of ARRL at 30.

[23] ARRL, *Additional Testing of the BPL System in Briarcliff Manor, NY* at §§ 1.3, 1.4 (report date Dec. 28, 2005). Linked at:

D. THE COMMISSION HAS ADEQUATELY DEFENDED ITS CHOICE OF EXTRAPOLATION FACTOR.

ARRL continues to attack the Commission's use of a 40 dB/decade extrapolation factor below 30 MHz.[24] Except for one reference to the newly released materials,[25] ARRL largely reiterates its previous arguments in favor of 20 dB/decade.[26]

As CURRENT explained earlier, taking measurements on the extrapolation factor is inherently difficult, so the resulting data tend to vary. The data plausibly support a range of values, including 40 dB/decade.[27]

ARRL agrees with us on the difficulties of getting good data: "[T]he measurement of field strengths on frequencies below 30 MHz is complex, especially *in situ*."[28] An appendix to ARRL's comments spells out some of the reasons.[29] But then, in a puff of smoke, ARRL pulls

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http://www.arrl.org/tis/info/HTML/plc/filings/Briarcliff-Complaint-Engineering-0106.pdf

[24] *See generally* Comments of ARRL at 47-58.

[25] Comments of ARRL at 48. ARRL's Exhibit D also cites various standards, all of which acknowledge that propagation inside the near-field/far-field transition boundary decays at rates of 40 dB/decade or greater. We take up this issue below.

[26] Comments of ARRL at 49, 52.

[27] Comments of CURRENT Technologies, LLC at 5-6 (filed Sept. 23, 2009).

[28] Comments of ARRL at 54.

[29] "[I]t is not possible to accurately measure extrapolation in the complex *in situ* environment surrounding power lines, unless a large number of measurements could be made. Unfortunately, for most installations, it is not possible to make a large number of measurements . . . ." Comments of ARRL, Exhibit C at 5.

out from these inconclusive data the conclusion that the "scientifically valid extrapolation standard is in fact 20 dB/decade; not 30 dB, not 40 dB."[30]

CURRENT disagrees. The record as a whole simply does not support 20 dB/decade as the sole justifiable value. The Commission's initial choice of 40 dB/decade option was, and remains, an empirically valid option, and a better description of BPL operations than 20 or even 30 dB/decade.

The Administrative Procedure Act ("APA") does not require the Commission to reach the one right answer (if one exists), or even the best available answer – merely one within a "zone of reasonableness."[31] That is, the Commission need only articulate a "rational connection between the facts found and the choice made."[32] Where a "highly technical question" is involved, as here, "courts necessarily must show considerable deference to an agency's expertise."[33] The 40 dB/decade value passes all applicable legal tests with flying colors.

ARRL nonetheless tries to argue that the data in the record support only the 20 dB/decade value, and that the data are beyond question. Both claims are untrue. CURRENT's first-round comments noted that all of the relevant studies yield extrapolation factors well above 20 dB/decade.[34] The study on which ARRL relies most heavily, "Ofcom 3" in Crieff,

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30 Comments of ARRL at 59.

31 *ExxonMobil Gas Mktg. Co. v. FERC*, 297 F.3d 1071, 1084 (D.C. Cir. 2002), *cert. denied*, 540 U.S. 937 (2003).

32 *ARRL v. FCC*, 524 F.3d at 233, *citing Motor Vehicle Mfrs. Ass'n of the United States, Inc. v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 43 (1983).

33 *Id., citing MCI Cellular Tel. Co. v. FCC*, 738 F.2d 1322, 1333 (D.C. Cir. 1984).

34 Comments of CURRENT Technologies, LLC at 6-7 (filed Sept. 23, 2009).

Scotland,[35] shows an extrapolation factor far above 20 dB/decade in the 10-30 meter range, which bridges between the typical measurement distance and the rated distance for Part 15 standards.[36]

In addition to misreading the data, ARRL rests much of its argument on a logical error. In particular, it supposes two contradictory propositions to be simultaneously true: that Access BPL systems comprise large radiating systems, and that the far field region begins very close to the antenna.[37] Correcting this error yields a much larger extrapolation factor than ARRL acknowledges.

If the first point is true – if BPL-equipped lines function as large, distributed antennas – then the near field extends well beyond 30 meters from the line.[38] Hence, all extrapolation takes place in the near field. The attenuation with distance is much steeper in the near field than beyond it. Regardless of what happens farther out, 40 dB/decade is a conservative estimate in the near field. On the other hand, if ARRL's second proposition is true – if the far field begins very close to the antenna – it follows that the antenna must be functioning similarly to a point source.[39] The extrapolation factor for a point source is close to 40 dB/decade.[40]

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35 Comments of ARRL at 49.

36 *See* Comments of CURRENT Technologies, LLC at 7 (filed Sept. 23, 2009).

37 The near field is a region immediately adjacent to an antenna where propagation characteristics are very different from those farther away. The near field is bigger at lower frequencies and for larger antennas. Beyond the near field is the far field, which extends to infinity.

38 *See* Appendix A.

39 *See* Appendix A.

In short, one of ARRL's two assumptions must be wrong. Either way, the surviving assumption shows the extrapolation factor to be in the vicinity of 40 dB/decade.

The Commission asks whether it should change the extrapolation factor below 30 MHz to 30 dB/decade.[41] Even if the Commission can find some justification for that value, on the whole, the backing for 30 dB/decade is worse than for 40 dB/decade. CURRENT agrees with the Commission that "40 dB per decade continues to best describe the attenuation rate of emissions from BPL systems."[42] In view of that finding, and given the absence of anything in the comments that definitively says otherwise, for the Commission to change values now would be both irrational and unnecessarily detrimental to BPL, including the vast majority of existing systems having no history of interference.

E. THE COMMISSION NEED NOT ADOPT A "SLIDING SCALE" OF EXTRAPOLATION FACTORS.

ARRL argues the Commission cannot reasonably establish one extrapolation factor below 30 MHz and another above 30 MHz, since there is no abrupt change in the physics between 29.999 MHz and 30.001 MHz.[43]

In theory ARRL is right about the physics. But regulation is often a matter of drawing bright lines through gray areas. Wherever one puts the margin, there will always be marginal cases.

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[40] Notice at ¶ 13 n.33 ("[A]n extrapolation factor of 40 dB per decade treats emissions as if they attenuate at a rate inversely proportional to the square of the distance from the emitter ($1/r^2$)"). An attenuation of $1/r^2$ is characteristic of a point source.

[41] Notice at ¶¶ 37-38.

[42] Notice at ¶ 37.

Take the setting of speed limits – say, 60 mph on a particular roadway. Of course this does not mean the road is always safe at 59.9 mph, and always dangerous at 60.1 mph. The "true" safe speed depends on traffic density, road surface, visibility, presence of pedestrians, and many other factors, often changing from moment to moment. But drivers need clear guidance, and the police need clear enforcement criteria. The highway authorities must pick a reasoned number under the circumstances and stick with it.

The Commission faces similar problems with every technical regulation. For example, consumer digital devices such as laptops and iPods are permitted to emit stray radio-frequency signals up to limits specified in the rules. Above 960 MHz, that limit is 75 nanowatts.[44] No one thinks these devices will always cause harmful interference at 76 nW, and never at 74 nW. Again, real-world practicalities require a reasoned, fixed line, even though real-world physics says no absolute line exists. Part of the Commission's job is to promulgate a specific, reasoned rule notwithstanding variability in the data. It has properly done so here, even though the values above and below 30 MHz may not absolutely match the actual (and hard to measure) attenuations at every frequency.

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[43] Comments of ARRL at 51-52.

[44] 47 C.F.R. § 15.109(a). The rule is phrased as 500 μV/m at 3m, which is mathematically equivalent to 75 nW or –41.3 dBm.

CONCLUSION

Nothing in the newly released data, or in the newly filed comments, justifies any change to the existing rules.

Respectfully submitted,

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APPENDIX A

As discussed in part D, above, ARRL argues both that a BPL device functions as a large radiator, and that frequencies above 4.78 MHz are in far field radiation beyond 10 meters.[a] Both cannot be right.

ARRL states that the far field region begins at a distance of $\lambda/2\pi$.[b] This is incorrect because it does not take into account the size of the radiating element. Basic antenna theory provides that far field radiation behavior occurs only when multiple criteria are met that depend on both wavelength λ and the largest dimension of the antenna, D: [c]

$$r > 2D^2/\lambda$$

$$r >> D$$

$$r >> \lambda$$

Usually the far field is taken to begin at a distance given by

$$r > 2D^2/\lambda$$

At frequencies below the VHF region, where the antenna may be small compared to the wavelength, the far field distance may have to be greater than $(2D^2/\lambda)$ in order that the above conditions be satisfied.[d]

Thus, the maximum dimension of the radiating structure is a fundamental consideration n determining the region where near-field radiation propagation rules dominate. ARRL ignores this fact. Yet ARRL states overhead power lines will serve as large radiators.[e] If one takes the dimension of the radiating structure at 10m, the far-field conditions are not satisfied until the measurement point is well past 30 meters at all frequencies below 30 MHz. As such, the data cited in ARRL's filing show characteristics much closer to 40 dB/decade.[f]

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[a] Comments of ARRL, Exhibit C at 9.

[b] *Id*. at 10.

[c] Warren Stutzman and Gray Thiele, *Antenna Theory and Practice*, page 24-25. John Wiley and Sons, New York, NY. 1981.

[d] *Id*.

[e] Comments of ARRL, Exhibit C at 11.

[f] Comments of ARRL, Exhibit D.

Additionally: From the relationship ($r > 2D^2 / \lambda$) for the far field, it follows that if the near field is very small, then r is very small, and hence $D << \lambda$. The emitter therefore approximates a point source, and must exhibit a 40 dB/decade extrapolation factor.

A point source by definition radiates uniformly in all directions and therefore the power is uniformly dispersed across a sphere with its center at the radiating point. The flux density is proportional to the surface area of the sphere, which in turn is proportional to the square of the radius. The radiation density therefore reduces as the square of the radius from the point source. This is equivalent to yields a 40 dB/decade extrapolation factor.

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