

**§ 303–70.1 When must we authorize payment of expenses related to an employee's death?**

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(e) Performing official duties as determined by the head of agency and be a covered employee as provided in § 303–70.700.

■ 3. Add Subpart H to read as follows:

**Subpart H—Transportation of Immediate Family Members, Baggage, Household Goods, and Privately Owned Vehicle for Law Enforcement Assignment**

Sec.

303–70.700 When an employee dies as a result of personal injury sustained while in the performance of the employee's law enforcement duties, either on official travel duties away from the official station, or at the current official station, must we provide transportation for the employee's immediate family, baggage, and household goods to an alternate residence destination?

303–70.701 What relocation expenses must we authorize for the immediate family under § 303–70.700?

303–70.702 Must we pay transportation costs to return the deceased employee's privately owned vehicle (POV) from the temporary duty (TDY) location or from an official station OCONUS under § 303–70.700?

**Subpart H—Transportation of Immediate Family Members, Baggage, Household Goods, and Privately Owned Vehicle for Law Enforcement Assignment**

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Yes, if the head of the agency concerned (or a designee) determines that the employee died as a result of personal injury sustained while in the performance of the employee's duties, and the employee was:

(a) A law enforcement officer as defined in 5 U.S.C. 5541;

(b) An employee in or under the Federal Bureau of Investigation who is not described in paragraph (a); or

(c) A Customs and Border Protection officer as defined in 5 U.S.C. 8331(31).

**§ 303–70.701 What relocation expenses must we authorize for the immediate family under § 303–70.700?**

If the place where the immediate family will reside is different from the place where the immediate family resided at the time of the employee's death, and within the United States,

then the agency must approve the following expenses:

(a) Transportation of the immediate family;

(b) Moving of the household goods of the immediate family, including transporting, packing, crating, draying, and unpacking, not to exceed 18,000 pounds net weight;

(c) Storage of household goods moved pursuant to paragraph (b) of this section, not to exceed 90 days; and

(d) Transportation of one privately owned motor vehicle.

**§ 303–70.702 Must we pay transportation costs to return the deceased employee's privately owned vehicle (POV) from the temporary duty (TDY) location or from an official station OCONUS under § 303–70.700?**

Yes. The agency must pay costs associated with returning the POV from the following:

(a) TDY location to the employee's permanent official station, if the agency had authorized the use of the employee's POV at the TDY location as being advantageous to the Government; or

(b) Official station OCONUS to the employee's former actual residence or alternate destination as approved by the agency, if the agency determined that the use of the employee's POV was required accordance with Chapter 302, Part 302–9 of this title.

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**FEDERAL COMMUNICATIONS COMMISSION****47 CFR Part 15**

[ET Docket No. 04–37; ET Docket No. 03–104; FCC 11–160]

**Broadband Over Power Lines**

**AGENCY:** Federal Communications Commission.

**ACTION:** Final rule.

**SUMMARY:** This document affirms the Commission's rules for Access Broadband over Power Line (Access BPL) systems. The Commission also makes certain minor modifications to improve and clarify the rules. These rules provide an appropriate balance between the dual objectives of providing for Access BPL technology that has potential applications for broadband and Smart Grid while protecting incumbent radio services against harmful interference.

**DATES:** Effective December 21, 2011.

**ADDRESSES:** Federal Communications Commission, 445 12th Street SW., Washington, DC 20554.

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**SUPPLEMENTARY INFORMATION:** This is a summary of the Commission's Second Report and Order, ET Docket Nos. 04–37 and 03–104, FCC 11–160, adopted October 20, 2011 and released October 24, 2011. The full text of this document is available for inspection and copying during normal business hours in the FCC Reference Center (Room CY–A257), 445 12th Street SW., Washington, DC 20554. The complete text of this document also may be purchased from the Commission's copy contractor, Best Copy and Printing, Inc., 445 12th Street SW., Room, CY–B402, Washington, DC 20554. The full text may also be downloaded at: <http://www.fcc.gov>.

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**Summary of the Second Report and Order**

1. In this Second Report and Order (Second Order), the Commission fundamentally affirms its rules for Access Broadband over Power Line (Access BPL) systems. The Commission also makes certain minor modifications to improve and clarify the rules. These rules provide an appropriate balance between the dual objectives of providing for Access BPL technology that has potential applications for broadband and Smart Grid while protecting incumbent radio services against harmful interference.

2. The Commission adopted rules for Access BPL systems in 2004 and affirmed those rules in 2006. The BPL rules were challenged by the national association for amateur radio, formally known as the American Radio Relay League (ARRL) in the United States Court of Appeals for the District of Columbia in *ARRL v. FCC*. In *ARRL v. FCC*, the court directed the Commission to: (1) Make part of the rulemaking record unredacted versions of several staff technical studies which the Commission considered in promulgating the rules, (2) provide a reasonable opportunity for public comment on those studies, and (3) provide a reasoned explanation of its choice of the extrapolation factor for use

in measuring radiated emissions from Access BPL systems. In response, the Commission issued a *Request for Further Comment and Further Notice of Proposed Rulemaking* in this proceeding (*RFC/FNPRM*). In the *RFC/FNPRM*, the Commission took its first step in responding to the directives of the court in *ARRL v. FCC* and also took that opportunity to review the Access BPL extrapolation factor and propose certain changes to the BPL technical rules that appeared appropriate in view of new information and further consideration of this matter. In this Second Order, the Commission completes its action addressing the court's concerns and its proposals in the *RFC/FNPRM*. It finds that the information submitted in response to the *RFC/FNPRM* does not warrant any changes to the emissions standards or the extrapolation factor. However, the Commission is making several refinements to its Access BPL rules. In particular, it is: (1) Modifying the rules to increase the required notch filtering capability for systems operating below 30 MHz from 20 dB to 25 dB; (2) establishing a new alternative procedure for determining site-specific extrapolation factors generally as described in the *RFC/FNPRM*, and (3) adopting a definition for the "slant-range distance" used in the BPL measurement guidelines to further clarify its application. The Commission finds that the benefits of the changes to the rules outweigh their regulatory costs.

3. Throughout this proceeding and in its appeal to the court, the ARRL has argued that more restrictive technical standards are needed to protect the amateur radio service from interference caused by leakage of radiofrequency (RF) emissions from Access BPL systems. The Commission initially crafted rules for BPL systems that were based on our existing emission standards for carrier current communications systems—narrow-band devices that couple RF energy onto power line wiring for communication purposes—with a number of additional requirements to promote avoidance and resolution of harmful interference to licensed services that might occur in the context of BPL operations. The Commission subsequently affirmed those rules in response to petitions for reconsideration by various parties, including ARRL. In this process, it has specifically rejected as unnecessary repeated requests by ARRL for tighter emissions controls on Access BPL operations. In response to the court's direction, it provided opportunity in the *RFC/FNPRM* for interested parties to

address the BPL technical rules and the information developed by our staff that we considered in establishing those rules, explained its rationale for the extrapolation factor used in measuring BPL emissions, expressed its tentative satisfaction with the extrapolation factor adopted, while soliciting comment on whether another value would be more appropriate, and proposed a procedure for determining site-specific extrapolation factors. The Commission has completed its response to issues raised under the court's directive.

4. The Commission has established a regime of rules for Access BPL systems that will provide a robust environment for the development and deployment of this important new technology option for delivery of broadband internet/data services while at the same time minimizing the potential for interference to licensed services caused by leakage from power lines of the RF energy used by BPL transmissions. As observed in the *BPL Order*, there is some potential for increased harmful interference from BPL operations, particularly in locations within a short distance of the power lines used by this technology. Consistent with our responsibilities for managing the interference potential of devices which can interfere with radio under Section 302 of the Communications Act, the Commission has developed a set of rules for BPL devices and systems that attempts to minimize instances of interference while allowing BPL systems to operate in a viable manner to serve the needs of the American public. In this regard, the Commission has stated and continues to hold that, on balance, the benefits of Access BPL for bringing broadband services to the public are sufficiently important and significant so as to outweigh the limited increase in potential for harmful interference that may arise. The Commission also agrees with NTIA that while some cases of harmful interference may be possible from Access BPL emissions at levels at or below the part 15 limits, the potential benefits of Access BPL service warrant acceptance of a negligible risk of harmful interference that can be managed and corrected as needed on a case-by-case basis.

5. To minimize the potential for harmful interference, facilitate its resolution where it may occur, and address cases where its possible occurrence could impact critical services, the Commission adopted additional regulatory measures beyond the emissions limits in the part 15 rules. These additional measures generally require Access BPL operators to reduce

emissions or avoid operation on certain frequencies or in certain locations in order to protect licensed services, to use equipment that can alter its operation by changing frequencies to eliminate harmful interference, to provide information that will assist the public in identifying locations where Access BPL operations are present and provide notice to radio users before commencing local BPL operations in a publicly accessible database. In this manner, the Access BPL rules provide an effective means for limiting harmful interference and ensuring that any instances of harmful interference that may occur can be quickly identified and resolved. As emphasized in the *BPL Order*, Access BPL systems will continue to be treated as unlicensed part 15 devices and as such will be subject to the conditions in § 15.5(b) of the rules that they not cause harmful interference and that they cease operation if they do cause such interference, as required by our rules. Upon examination of the information and comments received in response to the *RFC/FNPRM*, the Commission continues to believe that these measures are adequate and appropriate for managing the potential for harmful interference to all licensed radio services that operate on the bands used internally by BPL systems, including the amateur radio service.

6. The Commission is not persuaded by ARRL's newest technical submissions, including the reports/standards referenced in its November 2010 and June 2011 *ex parte* comments, or its assertions regarding the information in the unredacted presentations and in the additional information it recently introduced into the record in July 2009 that our assessment of the interference potential from BPL operations was incorrect or inappropriate, or that modifications to the BPL emissions limits and other technical rules to provide additional protection for the amateur service are warranted. While there is much valuable and valid information and analysis in ARRL's technical presentations, there are additional considerations that previously led us to draw different conclusions and still lead us to maintain those conclusions now.

7. With regard to the redacted portions of the staff presentations and the preliminary information from early staff work that was released in July 2009, the Commission was, of course, aware of that content and it was also aware of other considerations and facts that bear on the various BPL technical issues. Notwithstanding ARRL's apparent belief that the full content of the staff presentations should have led

us to the conclusion it prefers, the Commission found, and continues to find, differently with respect to the regulatory measures that are needed to protect the amateur service from interference from BPL operations. The presentations in those informally conducted experiments were part of our initial internal investigation of BPL and, while there is value in them, they are not the sole source of our information on BPL performance. In this regard, the Commission considered all of the available information on BPL systems and their performance, submissions in the comments and other publicly available information. It also observes that some of the staff presentations on which ARRL focuses were of experimental systems that used early implementations of BPL equipment, developed before the *BPL Order*, that do not appear to have complied with the new rules; additionally, information on other system implementations, particularly our work with the Manassas, VA system, showed different performance characteristics than the systems ARRL criticized. In some cases, ARRL simply (and incorrectly) draws different conclusions from those presentations than we do. Also, the assessments and recommendations in the redacted portions of the presentations merely reflect the views of the Laboratory engineers who performed the testing and analysis; they do not necessarily reflect the consensus view of other engineers, the management of the Laboratory or of OET. Indeed, individual views are often conflicting, but are encouraged in the interest of producing vigorous debate to lead to a thoroughly considered recommendation and decision.

#### **The Potential for Harmful Interference**

8. In the *BPL Order*, the Commission, with concurrence from NTIA, concluded that the current emission limits will restrict Access BPL systems to low emitted field strength levels in comparison to the signals of licensed radio operations. It found that the effect of these limits will be to constrain the harmful interference potential of these systems to relatively short distances from the power lines that carry the BPL signals. The Commission also recognized that some radio operations in the bands being used for Access BPL, such as those of amateur radio licensees, may occur at distances sufficiently close to power lines as to make harmful interference a possibility. The Commission stated that it believed those situations can be addressed through interference avoidance techniques by the Access BPL provider such as

frequency band selection, notching, or judicious device placement, and it adopted rules to facilitate such solutions.

9. The Commission agreed with ARRL that Access BPL on overhead lines is not a traditional point-source emitter, but not with its argument that Access BPL devices would cause power lines to act as miles of transmission lines all radiating RF energy along their full length. In this regard, the Commission observed that the part 15 emission limits for carrier current systems have proven very effective at controlling interference from such systems. Also, it indicated that the design and configuration of Access BPL systems would be inconsistent with the development of cumulative emission effects for nearby receivers. The Commission further concluded that because the BPL emissions level decreases significantly with distance perpendicular from the line, the potential for interference also decays rapidly with distance from the line.

10. The Commission recognized that Access BPL systems present concerns for licensed users in the high frequency (HF) and lower portions of the very high frequency (VHF) bands, given the propagation characteristics of RF signals in the range of frequencies being used for these systems, the diversity of users of these frequencies, and the fact that Access BPL devices could be installed at many locations in an area. While it concluded that there is little likelihood that harmful interference would occur from Access BPL operations at the signal levels allowed under the current part 15 emission limits, it acknowledged that such interference could occur in limited situations despite the intentions of BPL operators. To address this interference potential, the Commission required BPL operators to comply with additional interference mitigation techniques. It stated that such steps should be taken particularly in those cases where the occurrence of interference would affect critical services or where interference could be anticipated to occur. The interference mitigation measures for critical services include exclusion from operating on certain frequency bands and exclusion from operation in certain areas. For all services, the interference mitigation provisions require that BPL system operators have the ability to remotely cease operation or apply frequency avoidance (notching) on bands where licensed services are receiving interference. BPL operators were required to be able to notch their operations on affected bands to a level 20 dB below the part 15 emissions limit

for frequencies below 30 MHz (*i.e.*, 1/100th of the emissions limits for other unlicensed unintentional radiators).

11. In the *BPL Reconsideration Order*, the Commission affirmed its selection of 20 dB below the part 15 emissions limit as the minimum notching capability for frequencies below 30 MHz. It also revised the rules to specify that where an Access BPL operator implements such notching, the operator need not provide further protection to mobile operations, nor will the operator be required to resolve complaints of harmful interference to mobile operations by taking steps over and above implementing the "notch." The Commission found that, while this level may be above the noise floor, reception of signals in mobile operating conditions is generally not reliable at levels at or below that level and thus does not warrant protection.

12. The Commission disagrees with ARRL that the recently released materials show interference potential from Access BPL systems to be significantly greater than that which we anticipated in the *BPL Order*, that such interference will be preclusive of amateur operations over large areas, or that the current rules are not adequate to resolve any interference that might occur. Rather, ARRL's in-depth focus on that material is in some aspects consistent with the Commission's own assessments, in other aspects incorrect, and, importantly, in many aspects does not account for the real world conditions affecting the propagation of RF emissions at HF frequencies. While ARRL provides significant information on the standard engineering principles concerning the attenuation rate of emissions from line emitters, it is mistaken as to how the attenuation rate should be viewed for purposes of measuring BPL emissions. In this regard, the Commission again concludes that 40 dB/decade is a best estimate of the expected attenuation rate/extrapolation factor in the conditions in which measurements are made under the Access BPL measurement guidelines. The Commission finds no information in the comments or the newly submitted information in ARRL's November 2010 and June 2011 *ex parte* submissions that would warrant modification of the Access BPL rules to require notching of all amateur bands at notch depths of at least 35 dB, or otherwise provide additional protection for the amateur service. However, in reviewing the requirement that Access BPL systems be capable of reducing their emissions by 20 dB in a given frequency band and current developments in BPL equipment, the

Commission now finds that it would be appropriate to increase this required “notching” capability by 5 dB, to 25 dB for BPL systems operating below 30 MHz. It responds to the comments with respect to each of these sets of materials sequentially listed here.

#### Unredacted Staff Presentations and Newly Submitted Materials

13. In its comments, ARRL argues that the unredacted staff presentations show that:

i. Access BPL is not a point-source emitter; it is a distributive system that has significant interference potential over a wide area at significant distances from (and along) the power line carrying BPL signals. It contends that the Commission’s measurements show that there is virtually no signal decay along the power line 230 meters from the coupler.

ii. The proper distance extrapolation factor for assumed signal decay with distance from the power line is much closer to 20 dB/decade of distance (20 log R) than to the 40 dB/decade of distance (40 log R) adopted by the Commission for frequencies below 30 MHz.

iii. Access BPL has a considerably higher interference potential to licensed radio services than the Commission concluded in the BPL Order if operated at the maximum radiated emission levels permitted by the Commission’s part 15 rules (and the BPL rules adopted in the BPL Order). Specifically, interference to licensed mobile radio receivers is very likely for very long distances along a power line. The presentations also show that systems operating at the part 15 emission limits will be at least 25–35 dB stronger than the median values of man-made noise at 30-meters distance. Extrapolating this to a mobile antenna closer to the lines results in an even higher noise level.

iv. The Commission erred in concluding that mobile Amateur stations would be protected from interference if, in response to an interference complaint, the BPL operator reduced the BPL radiated emission level from the offending portion(s) of the BPL system by 20 dB below the maximum radiated emission level permitted for part 15 devices generally. That remedy falls far short of reducing BPL noise to the level of ambient noise in residential environments found by Commission’s technical staff, and falls far short of reducing BPL wideband noise levels to the point that mobile communications can be conducted in areas substantial distances from the power line.

v. Measurement of BPL radiated emissions should be done at heights not lower than in the same horizontal plane as the overhead power line.

14. First, the Commission agrees with ARRL that a BPL system does not behave as a point-source emitter. Neither, however, can it be analyzed as a line emitter. Analysis and prediction of RF propagation in the HF frequency region is extremely complex and difficult, and particularly at locations close to the ground, as the Commission, ARRL and many other commenters have acknowledged throughout this proceeding. The Commission’s intent in the BPL Order was not to say that power lines are point-source radiators, but rather simply that the interference potential lessens with distance down the line from the coupler—though this occurs at rates that can vary significantly with power line topology.

15. ARRL points out that one of the video files in the staff materials released by the Commission in July 2009 shows interference to mobile reception of signals in the amateur 20-meter band (14.0–14.35 MHz). Specifically, it states that the video of the Briarcliff Manor system recorded on August 17, 2004 (Briarcliff Video #5) shows in a graphic, compelling manner the severe and constant interference caused by the BPL system to amateur reception over huge geographic areas which obviously precluded essentially all Amateur HF communications in the area. It submits that no objective observer of this video could possibly conclude that the level of BPL radiated emissions permitted by the Commission’s Part 15 rules is acceptable. ARRL is correct that the interference that is apparent on Briarcliff Video #5 is not acceptable and would not be permissible under either our part 15 rules or the system operator’s experimental license. However, while interference can occur from BPL operations along a stretch of power lines as shown in that and other videos in the preliminary materials released in July 2009, the Commission did not and do not find this example to substantiate a need for more restrictive rules on BPL systems. First, it does not appear that any of the mitigating features that are required in the rules had been applied to this system. In addition, our staff did contact the licensee about interference from that system several times over the course of its operation and the operator took steps first to cease operation on the amateur frequencies and then to install new equipment that had notching capability. Subsequent examination of that system by field agents of the Commission’s Enforcement Bureau found no

interference, which substantiates the effectiveness of our rules when properly observed. Also, as indicated by the primary and secondary title screens of Briarcliff Video #5, the system was notched only in the 20-meter amateur band, and not in the 15-meter amateur band, for which that video was recorded. Thus, the Commission did not and do not consider the interference that appears in Briarcliff Video #5 to be representative of the performance of a system operating in accordance with the set of rules it set forth for Access BPL systems.

16. The Commission also sees no merit in ARRL’s argument that statements on the same presentation slide concerning an interference problem from the Phonex carrier current system to ARINC aeronautical communications and opining that compliant Access BPL “may be worse” should have served as a factor in its decision on protection for the amateur service. In the BPL Order, the Commission recognized the critical nature of aeronautical communications and, given the free space propagation path from a power line to an aircraft, excluded Access BPL systems from operating on frequencies used by that service. With respect to the Phonex case, the Commission also observes that the Phonex system at issue might not have been the source of the interference with ARINC’s communications and its performance therefore cannot be used as an empirical basis for establishing any benchmarks with respect to the interference potential of BPL systems.

17. ARRL next observes that another presentation slide in the Briarcliff Manor presentation recommends that the Commission “impose [a] 5 dB height correction [factor]” on measurements and a “20 log R extrapolation factor” if it is going to allow BPL on medium voltage (MV) overhead power lines and should use a 20 dB/decade extrapolation factor for signal decay with distance from the power line. It observes that the presentation states that this “reduces interference [from BPL] to fixed stations.” Basing the BPL emissions limits and measurement procedures on an attenuation rate of 1/R, *i.e.*, 20 dB/decade would, of course, reduce signal levels and thereby provide additional protection to licensed services against interference. The Commission notes that the slide in question does not provide a “recommendation” as claimed by ARRL, rather, it only presented several options for other staff and management to consider in its deliberations. Further, as the Commission concluded previously, it does not believe that such

additional protection is needed or warranted, but rather hold that the part 15 “no interference requirement,” the part 15 emissions limit for carrier current systems, and the interference mitigation measures it adopted in the *BPL Order* collectively provide sufficient protection to licensed services from the potential for harmful interference from Access BPL operations. The Commission also continues to find that the attenuation rate of emissions from power lines is typically higher than 20 dB/decade and varies with location. At distances within 30 meters of the power line and when using the slant-range measurement procedure prescribed in our measurement guidelines,  $1/R^2$ , *i.e.*, 40 dB/decade, properly describes the expected attenuation rate at frequencies below 30 MHz, and variability around that rate is also expected.

18. It is also important to understand, as the Commission discussed in the *RFC/FNPRM* and ARRL largely ignores, that RF propagation in the lower frequencies ranges, and particularly at frequencies below 30 MHz, is greatly affected by environmental factors, so that there is significant variability in propagation from place to place. These include ground absorption and conductivity, terrain, vegetation, and the presence of structures and other man-made objects, including additional power lines arrayed on pole/towers in the near-field of emissions from a power line carrying Access BPL transmissions. In some cases, emissions from BPL systems that are expected to be compliant with the rules will attenuate with distance at relatively high rates and be well below the part 15 limits while emissions from other systems, or even from the same system but at a different location, will attenuate at a relatively lower rate and exceed the part 15 limits. The Commission is aware of these variabilities in this complex operating environment and to account for it, has adopted additional provisions for mitigating harmful interference that are set forth in the rules. In addition, recognizing this variability, it did not base our assessment of interference potential on any standard performance factor, such as an attenuation rate by itself, but rather on the successful past performance of our existing standards and the availability of suitable approaches for managing the potential for harmful interference and correcting any harmful interference that may occur.

19. The Commission has also fully considered the issue of how to measure Access BPL emissions, including whether a 5 dB correction factor was

needed for Access BPL measurements below 30 MHz. In the *BPL Order*, it concluded that the existing measurement procedure that provides for measurement of the magnetic field at 1-meter height with no correction factor was appropriate for measurements in that frequency region. There is no additional information in the presentation summaries that leads us to find that this decision should be changed.

20. ARRL points out that slide 20 of the Briarcliff Manor presentation listed options of notching or mandatory advance coordination for protection of low-VHF public safety channels and that the Commission did not adopt either of those options but instead put in place a notification requirement. It also observes that the same slide listed the 50–54 MHz amateur band that is typically used for both mobile and fixed operations and the Commission did not acknowledge the interference potential to amateur operations in that band and offered no remedy for it. In the *BPL Order*, the Commission determined that public safety systems, because of the often critical and/or safety-of-life nature of the communications they provide, merit the additional protection of advanced notice of BPL operations. The Commission stated that an advance notification would provide a public safety operator with an opportunity to assess whether there are portions of its geographic area of responsibility about which it should make special arrangements with the Access BPL operator in order to avoid interference. The Commission did not address the frequencies used by the amateur service on an individual basis, but rather concluded that amateur radio frequencies generally do not warrant the special protection of frequency exclusion that was afforded frequencies reserved for international aeronautical and maritime safety operations.

21. ARRL observes that slide 21 of the Briarcliff Manor presentation predicts the potential for BPL to cause interference to mobile operations to be “high” to “very high.” It further observes that the same slide has a table indicating that the interference distance to fixed stations would be 62 meters at 2–8 MHz and 400 meters at 8–30 MHz in areas where the noise levels were at the International Telecommunication Union (ITU) “residential” level. It contrasts these statements with our findings in the *BPL Order* that the potential of Access BPL systems was “low” and observes that in the case of mobile communications where a vehicle is close to the power lines, the potential for interference will indeed be higher.

While the Commission again recognize that at some locations (including where nearby antennas are located above the height of the power line) the attenuation rate of Access BPL emissions will be lower and at other locations it will be higher, these levels are consistent with our interpretations that the interference potential is low such that it can be managed adequately with the additional interference mitigation measures and the “no harmful interference provisions” of part 15 that are also in our rules. In this regard, the distances from a power line to an amateur fixed receiver will be sufficiently short that if harmful interference were to occur, the recipient could readily identify its source and request that it be resolved. The Commission observes that International Broadband Electric Communications, Inc. (IBEC), a major operator of Access BPL systems, reports (with confirmation by ARRL in its comments) that it has been communicating with the local amateurs and emergency services in the areas it covers to implement a successful interference resolution process. It states that it has been able to resolve interference complaints, as they arise, under the framework of the existing Access BPL rules. This information provides confirmation of the processes and requirements the Commission established, when used in practice, are adequate to prevent most cases of harmful interference to licensed services, and to resolve quickly any instances of harmful interference that do occur.

22. *Spectrum Notching*. The rules provide for mitigation of BPL interference where it may occur by notching. In the *BPL Order* and the *BPL Reconsideration Order*, the Commission found that, for frequencies below 30 MHz, a 20-dB notch would appropriately address any harmful interference that might occur to mobile operations, given both the low signal levels allowed under the part 15 emission limits and the fact that a mobile transceiver is generally only in one place for a limited period and can readily be re-positioned to provide some separation from the Access BPL operation.

23. In its comments, ARRL argues that slide 13 of the Briarcliff Manor presentation summary references predictions from the *NTIA Phase 1 Study* that show that the noise floor would rise by more than 20 dB at nearly all points, and by 30 dB at most points, along a 340-meter modeled power line. It also notes that the slide states that in NTIA’s measurement activities, NTIA took occasional samples of noise power

along the line with the Access BPL system turned off and found noise levels lower than predicted by the ITU for residential areas. ARRL therefore contends that the 20-dB standard for the notching requirement is insufficient. The Commission initially noted that NTIA's sampling of noise power was only at a very limited number of locations and not sufficient to serve as the basis for a conclusion that the noise floor is lower than the levels recognized by the ITU. Further, there is not sufficient information in any of the submissions regarding changes in the noise floor to justify a change from our use of the well-established ITU-recommended levels for the noise floor in different environments.

24. In its November 2010 *ex parte* submission, ARRL provides additional comments that reference several recent domestic and international industry and governmental reports/standards to support its request for a 35-dB notch of all the amateur frequency bands. These documents include: (1) ITU-R Report SM.2158; (2) ITU-T G.9960; (3) IEEE P1901-2010; and (4) OFCOM Report on In-Home PLT devices. All of these documents mandate or recommend notching of the amateur frequencies. ITU-R Report SM.2158 states that the maximum allowable increase in the noise floor due to BPL emissions should not exceed 0.5 dB, based on the assumption that the fade margin of the amateur service in long distance communications is less than 1 dB. Based on this assumption, ARRL argues that a notch depth of 34 dB would be required if a 20-dB/decade extrapolation of the FCC emission limits is used and a notch depth of 43 dB would be needed if the existing extrapolation factor of 40-dB/decade is used.

25. In re-examining all of the information pertaining to the depth of the notching requirement, the Commission now finds that it would be appropriate to increase the required notching capability to be 5 dB greater than the 20 dB specification it initially adopted. Previously, the Commission observed that when operating with a 20-dB notch below 30 MHz, the maximum allowed emissions from an Access BPL system is 10 dB $\mu$ V/m at the part 15 measurement distance of 30 meters, a level which is at or only modestly above the noise floor in the HF bands at most locations. The Commission's intention was that Access BPL emissions in a notched bandwidth would not be significantly greater than the background noise at the distances normally used for protection against harmful interference from part 15 unlicensed devices. The Commission

also evaluated the potential for interference at closer distances that can occur when conducting mobile communications while traveling adjacent to roadside power lines. It observed that when extrapolated to values for the typical closest distance of a mobile antenna in motion from roadside power lines (approximately 6 meters horizontal distance and 8.5 meters vertical distance, for a slant range of 10.4 meters) and adjusted for the typical quasi-peak to average ratio of 4 dB for BPL devices operating at high duty factor, the part 15 limit corresponds to a root-mean-squared (RMS) field strength of 44 dB $\mu$ V/m for frequencies at or below 30 MHz. A 20 dB reduction would limit emissions to 24 dB $\mu$ V/m. The Commission concluded that given the high variability of the noise floor at HF frequencies, where increases of as much as 20 dB or more are common, mobile reception of relatively weak signals under 24 dB $\mu$ V/m is generally intermittent and not reliable because both the received signal and the ambient noise levels vary up and down (the received signal and noise energy levels generally do not rise and fall together) as the vehicle moves.

26. In carefully reviewing the record on this issue, the Commission acknowledged ARRL's point that the modeling in the *NTIA Phase 1 Study* predicts that Access BPL emissions on frequencies below 30 MHz that are at the part 15 limit would raise the mobile radio noise floor at 15 MHz and 25 MHz by 30 dB in 59% of residential locations. After a 20-dB notch, the BPL remaining emissions would still produce a noise floor increase of about 10 dB for mobile operations in residential locations at those frequencies. As the Commission observed in the *BPL Reconsideration Order*, there is considerable variability around the median noise level, such that increases of as much as 20 dB are common and reduce the reliability of signals at the margin of expected reception. While, the Commission continues to believe that the significant variability in background noise levels limits the reliability of HF signals below 30 MHz such that BPL emissions at a level of 24 dB $\mu$ V/m should not generally be considered harmful interference, it also understands that the 20 dB value for noise increases due to diurnal and seasonal factors is the maximum expected effect and that in many cases the daily variability in the noise floor levels will be somewhat less. The Commission has no specific information on the distribution of the diurnal and seasonal variability of noise

floor levels; however, it believes that an increase of 5 dB in the required notching capability, or half the 10-dB current margin of BPL emissions affecting mobile reception above the residential noise floor, according to NTIA's estimates as supported by ARRL, would take a more conservative approach and provide protection for amateur mobile operations in more instances, while continuing to recognize the variability in emissions that limit the service to mobile amateur receivers. Given our understanding supported by the assertions in the record that most BPL operators are already using notches of at least 25 dB, the Commission would expect the cost imposed by this requirement to be minimal or nil. It finds that the benefits of providing additional protection for licensed services outweigh any potential additional costs to BPL providers. Such benefits include a more integrated environment where BPL devices may share spectrum with licensed users, with lesser concerns for potential harmful interference. BPL devices bring expanded benefits to electric utility companies by allowing them to monitor, and thereby more effectively manage their electric power distribution operations. BPL also brings "last-mile" delivery of broadband services to some rural and underserved areas.

27. With respect to the new information in ARRL's November 2010 *ex parte* submission, first the Commission is not persuaded that a 0.5 dB increase in the noise floor as used in the ITU-R Report SM.2158 is a reasonable assumption for the numerous reasons it stated with respect to the significant variability in background noise levels at HF frequencies. Further, it appears that the 0.5 dB number was used in the ITU Report without any discussion, analysis or other explicit rationale. The Commission further noted that in its June 2011 *ex parte* submission, ARRL mentions that ITU-R Recommendation SM.1879, which refers to the above report, does recommend that stations operating in the Amateur Service be protected to a level such that noise at the protected station is not increased by more than 0.5 dB. Although ARRL provided calculations to relate the 0.5 dB increase in the noise floor with the part 15 limits to arrive at its requested 35-dB notch number, it again did not provide a rationale for using a 0.5 dB increase in the noise floor as the protection criterion at HF frequencies. With the exception of ITU-R Report SM.2158, the reports/standards submitted by ARRL in its November 2010 *ex parte* comments do not include

any analysis that shows that 35 dB or some other figure is the proper level of notching needed to protect amateur operations, but rather simply state as their recommendations and requirements a notching depth that existing BPL equipment can meet. The Commission also recognizes the ARRL's observation in its June 2011 *ex parte* submission that in the IEEE P1901–2010 standard there is a normative requirement for a 30-dB notch depth for the FFT OFDM (HomePlug) technology. While this voluntary industry standard is apparently being used by manufacturers of HomePlug In-House BPL equipment, it is more stringent than is necessary for our regulatory purposes and in any case does not apply to the Access BPL applications at issue herein. The Commission also does not find persuasive ARRL's argument that deeper notching can be implemented without adverse impact on the data rates of BPL technology. In this regard, the testing on which ARRL bases this claim was on In-House rather than Access BPL equipment and in any case our principal concern is with imposing regulation that is more restrictive than necessary rather than simply minimizing the impact that such regulation might have on some aspect of BPL equipment or its operation. While the Commission duly note the Republic of Korea's decision to require permanent notching of the amateur bands, the relevance of that determination by that country's regulatory body at that time to our present consideration is not readily apparent, and ARRL provides no information regarding either the radio environment or the regulatory objectives and standards that informed that decision by which the Commission might consider how those considerations might affect our own decision making.

28. The Commission recognizes that one of the documents referenced by ARRL, IEEE P1901–2010, is an industry standard for both Access and In-House BPL equipment authored by nearly a hundred entities that include BPL service and equipment providers and that this standard describes a 35-dB spectrum notching for compatibility with amateur radio services that can be supported by a type of BPL technology known as wavelet OFDM, as elucidated by UTC. Further, as ARRL submits, its scrutiny of systems listed in the BPL database indicates that existing BPL systems in the U.S. are generally notching the entirety of the HF amateur allocations, using equipment capable of notch depths of at least 35 dB. Thus, it appears that many BPL systems now in

operation may be voluntarily observing the notch depth and band avoidances that ARRL is requesting. While those industry practices are consistent with the ARRL's goals in this matter, the Commission nonetheless finds they are more stringent than are justified from a regulatory standpoint. In this regard, the Commission does not find that an increase in the required notching capability to a level above 25 dB is needed to protect against interference to amateur or any other licensed services. To require that all systems adhere to a *de facto* industry 35-dB notching standard would unnecessarily constrain BPL operators, as stated by UTC, and equipment manufacturers who might choose to design for a different level of operation that would comply with the notching level the Commission has determined will provide adequate protection. Further, to require that all of the amateur bands be notched would unnecessarily restrict BPL operations in areas/locations where no amateur operations are present that could receive interference.

29. The Commission sees no statistically-valid support for ARRL's position that the ambient noise levels have become so low as to contradict our conclusion here that a 25-dB notch is generally sufficient to protect licensed services. Further, for fixed stations, if a 25-dB notch is not sufficient to resolve observed harmful interference or other steps to resolve the interference are not successful, under § 15.5(c) of the rules, the operator is then, upon notification by a representative of the Commission, required to cease operation until the interference is corrected. In such cases, the interference might perhaps be resolved by using new equipment that includes a filter with a notch capability greater than 25 dB. The Commission believes, however, that the new 25-dB notching requirement will be sufficient to resolve the great majority of cases of harmful interference that might occur and therefore do not see a need to require that Access BPL systems routinely use equipment with greater notching capability.

30. In changing the notching level to 25 dB, the Commission is aware that Access BPL operators have already installed equipment with 20-dB notching capability in compliance with the rules and that there is some inventory of equipment built to that standard which has not yet been installed. While it believes that the greater level of protection provided by our rule change is prudent in the long term, it has not observed any cases to date where the notching afforded by existing equipment has not been

adequate to resolve interference. Accordingly, given the limited number of devices already deployed and manufactured, the Commission will not require their replacement or prohibit their installation for replacement or in new constructions. In order to afford manufacturers time to redesign their equipment to comply with the new, more conservative 25-dB notching requirement, the Commission will allow an 18-month period from the date this action is published in the **Federal Register** before the requirement becomes effective.

31. In its reply comments, ARRL submits that IBEC did not resolve interference complaints to amateur fixed stations by doing what the existing BPL rules require, other than compliance with the general part 15 requirement to correct any harmful interference. It states that instead, IBEC has avoided or resolved the interference by doing two of the things that ARRL has requested as modifications to the existing BPL rules: (1) IBEC avoided the use of Amateur bands in its installations, and (2) it has used state-of-the-art notch depths of 35 dB. The Commission observes that avoiding a frequency band where interference could occur is certainly an option that is contemplated under the rules. Using a notching capability with attenuation of greater than that required in the rules where needed is also consistent with the general requirement in part 15 rules that a device not cause harmful interference. The Commission does not, however, find the fact that equipment which can provide 35-dB notching capability is now available and IBEC's choice to use such equipment to be indicative that it should require that level of notching capability in all instances. Rather, while the rules will now require a notching capability of at least 25 dB, that level of attenuation will only be deemed sufficient for resolving harmful interference in the case of mobile operations; the system operator is still responsible for resolving harmful interference to fixed operations if the 25-dB notch capability is used and the interference remains. Under the notching rules the Commission adopted, a BPL system operator has the flexibility to install a notching capability greater than 25 dB or to implement other measures for resolving harmful interference in cases where the 25-dB notch is not sufficient. In this regard, IBEC did, in fact, take the steps required under § 15.611(c) of the rules—it configured its systems to be capable of remotely reducing power by 35 dB and adjusting operating frequencies to avoid site-specific, local use of the same

frequencies by licensed radio operations. A different operator might have chosen an alternative approach for complying with this rule.

#### Preliminary Documents Released in July 2009

32. Notwithstanding ARRL's contentions, the Commission did consider the information in the presentations in the *BPL Order* and in the formulation of our rules for regulating interference from Access BPL emissions. There are no new facts, information, or interpretations in those presentations or in ARRL's comments that are inconsistent with the Commission's previously stated understandings and findings. These presentations, as well as other information in this proceeding, show that Access BPL operations can raise the RF noise level to levels above the noise floor such that they can cause interference to amateur operations in the close vicinity of power lines on which the BPL signals are carried. As the presentations show, the area of interference is essentially limited to distances close to and along the power lines. While some interference is possible at locations close to the power line, the Commission believes that in the great majority of locations, interference will not occur to radio services because either propagation conditions limit the range of the Access BPL emissions or there is no licensed amateur station present and operating on the frequencies on which such emissions appear. The Commission sees no need to require an Access BPL operator to reduce emissions below the part 15 limits where there is no potential for interference. In addition, it requires that a database of Access BPL systems be established to allow amateur operators to identify BPL operations in their area before the systems commence operation so that they have an opportunity to alert the BPL operator of their presence before the system is activated. The Commission addressed specific points in ARRL's arguments in paragraphs 52 through 56 of this Second Report and Order.

33. The Commission also noted that throughout this proceeding and as new equipment that allows BPL operators to better manage their frequency use at specific locations has become available, it observed BPL operators taking active steps to locate and avoid interference to amateur operators. Given that identification and resolution of harmful interference can involve expenditures of staff time and resources for Access BPL providers and possibly the temporary disruption of service to their

subscribers, these providers have a strong incentive to take *a priori* steps to ensure that they avoid causing interference to the local radio services, including amateurs. Notwithstanding the occasional interference that was found by amateurs from the trial systems that were operated during the early phases of BPL development such as those examined in the staff presentations (and which, in some cases, were operating with emissions levels that were found to exceed the part 15 limits by amounts ranging from 1 to 4 dB), the Commission observed, as described by IBEC and CURRENT in their comments, that Access BPL operators are taking effective steps as contemplated in the *BPL Order* to avoid interference to amateur and other licensed services, including working with local amateur operators. Moreover, our own internal records on enforcement matters show only one complaint of interference from Access BPL to fixed licensed operations; that complaint was submitted recently and is under investigation at this time. In summary, the Commission sees no new information or reasoning in ARRL's submissions or other information regarding the three additional staff presentations in the preliminary materials released in July 2009 that would warrant changing the current rules and, specifically, it sees no need to further restrict the operations of BPL systems to protect licensed services.

#### Measurement Distance Extrapolation Issues

##### *The Extrapolation Factor*

34. *Overview.* In the *BPL Order*, the Commission set forth guidelines for measurement of the emissions from Access BPL systems. These guidelines, *inter alia*, specify that emissions from Access BPL devices operating below 30 MHz are to be measured for compliance with the radiated emissions limits in § 15.209 of the rules. Those limits are based on measurements made at 30-meters horizontal (lateral) distance from the device under test. However, for practical reasons associated with measurement in the field, the Access BPL measurement guidelines recommend that measurements should normally be performed at a horizontal separation distance of 10 meters from the overhead power line, and they also indicate that measurements can be performed at 3 meters if necessary because of ambient emissions, safety or practical considerations. The field strength of radiated emissions does, however, decrease with increasing distance from the emitter due to

propagation loss. Because of this attenuation with distance, the field strength of emissions from a device measured at the 3-meter or 10-meter distances specified in the guidelines will generally be higher than those measured at the 30-meter distance on which the emission standard is based. In order to apply the emissions standard consistently, the measurement results must be adjusted to account for distance attenuation when measurements are made at a distance other than 30 meters.

35. The Commission specified distance extrapolation factors to convert the BPL emissions measurements for frequencies below and above 30 MHz to appropriate values for tests made at the 3-meter and 10-meter distances recommended in the BPL measurement guidelines. For BPL operations on frequencies below 30 MHz, the frequency range at issue here, some commenters in the initial phase of this proceeding, including ARRL, recommended the use of an extrapolation factor of 20 dB/decade, while others recommended an extrapolation factor of 40 dB/decade. The Commission concluded in the *BPL Order* that "[g]iven the lack of conclusive experimental data pending large scale Access BPL deployments," it would "continue the use of the existing part 15 distance extrapolation factors" specified in the rules, *i.e.*, 40 dB/decade for frequencies below 30 MHz and 20 dB/decade for frequencies at or above 30 MHz, but with the distance measured as the slant-range distance from the overhead power line to the center of the measurement antenna rather than horizontal (lateral) distance from the nearest point of the overhead power line carrying the BPL signals to the center of the measurement antenna, as illustrated in Figure 1 of Appendix C, of this Second Report and Order. This is the horizontal (lateral) distance between the center of the measurement antenna and the vertical projection of the overhead power line carrying the BPL signals down to the height of the measurement antenna when measurements are taken at a point that is perpendicular to the power lines. It further stated that "if new information became available that alternative emission limit/distance standards or extrapolation factors would be more appropriate," it would revisit this issue at another time.

36. ARRL filed a petition for reconsideration of the Commission's decision in the *BPL Order* to use 40 dB/decade as the extrapolation factor for frequencies below 30 MHz. In support of its argument that an extrapolation factor of 20 dB/decade should be used, ARRL also submitted, through *ex parte*

comments, reports on three studies conducted by the United Kingdom's Office of Communications (OFCOM) and a standard by the Special International Committee on Radio Interference (CISPR) regarding emission measurements for BPL systems and a proposal for a sliding scale extrapolation factor based on a 1996 CISPR standard. The first OFCOM study, "*OFCOM, Ascom PLT Measurements in Winchester* (May 11, 2005)" (Winchester Study) reported measurements of an underground Access BPL trial system in Winchester, United Kingdom. In that study, OFCOM concluded that the electromagnetic field attenuates at a rate between 20 dB and 25 dB/decade at this BPL installation. The second OFCOM study, "*OFCOM, DS2 PLT Measurements in Crieff* (May 11, 2005)" (Crieff DS2 Study) reported measurements of an Access BPL trial system in Crieff, United Kingdom. That study concentrated only on the benefits of programmable notches in the equipment and did not provide any data on distance extrapolation. The third OFCOM study, "*OFCOM, Amperion PLT Measurements in Crieff* (May 11, 2005)" (Crieff Amperion Study) reported measurements of an overhead, pole-mounted Access BPL trial system, also in Crieff, United Kingdom. In the Crieff Amperion Study, OFCOM concluded that the emitted field attenuates at a rate of 28 dB/decade.

37. On reconsideration, the Commission found the OFCOM studies and the CISPR standard unpersuasive in that there was no "new" or convincing information not already known, and affirmed its decision to use the existing part 15 distance extrapolation factor of 40 dB/decade attenuation rate in the measurements of BPL emissions on frequencies below 30 MHz.

38. In *ARRL v. FCC*, *supra*, the court found that the Commission did not offer a reasoned explanation for its dismissal of empirical data that was submitted *ex parte* by ARRL, *i.e.*, the three OFCOM studies and additional ARRL analysis intended to suggest that an extrapolation factor of 20 dB/decade may be more appropriate for Access BPL. The court ordered the Commission either to "provide a reasoned justification for retaining an extrapolation factor of 40 dB/decade for Access BPL systems sufficient to indicate that it has grappled with the 2005 studies, or adopt another factor and provide a reasoned explanation for it."

39. The Commission acted to respond to the court's directive in the *RFC/FNPRM*. Therein, it provided a more detailed explanation of its reasons for

selecting 40 dB/decade as the extrapolation factor for frequencies below 30 MHz and in particular why it does not believe that the studies and technical proposal submitted earlier by ARRL provide convincing information that it should use an extrapolation factor that is different from (and, specifically, less than) 40 dB/decade as required in the second element of the court's directive in *ARRL v. FCC*. In summary of that explanation, the Commission stated that:

i. There were no significant studies that examined the very large number of measurements that would be needed to address the different site characteristics that affect the attenuation of emissions below 30 MHz;

ii. The studies submitted by ARRL in its 2005 *ex parte* provided only anecdotal information on two different types of installations (overhead and underground) from two single sites and also had certain methodological shortcomings; and

iii. With respect to its proposal for a sliding scale extrapolation factor, ARRL did not provide an explanation as to how its formula was derived or how to use it to determine the extrapolation factor, nor did it provide a rationale for selecting such a formula or information as to the relationship between the performance of emissions from BPL technology and the specifications for reduction of power line noise adopted in the standard.

40. In the *RFC/FNPRM*, the Commission also observed that since its adoption of the *BPL Reconsideration Order*, reports had become available on two new technical studies addressing attenuation of BPL emissions with distance, one by NTIA in October 2007 that described a second phase of its simulation study on the potential for interference from Access BPL systems (*NTIA Phase 2 Study*) and the other by the Federal Republic of Brazil (*Brazil Study*) in June 2008 that presented the results of a measurement study of BPL emissions. In addition, it noted that the IEEE working group on power line communications technology electromagnetic compatibility was working on a standard for EMC testing and measurements methodology for BPL equipment and installations (IEEE P1775/D2) that included a provision for determining extrapolation (distance correction) factors on a site-by-site basis using *in situ* measurements as part of its work on that standard.

41. In view of these new studies and consistent with its stated intention in the *BPL Order* to revisit the extrapolation factor if new information became available and the opportunity

provided by the Court's remand of the extrapolation factor, the Commission decided to conduct further rulemaking to review its decision on the extrapolation factor. It requested that interested parties submit additional comment and information on the BPL extrapolation factor and specifically asked that such comment and information address (1) The three studies and proposal for a sliding scale extrapolation factor submitted previously by ARRL as part of its *ex parte* filing of July 8, 2005 in this proceeding, (2) the *NTIA Phase 2* and *Brazil* studies with respect to their findings on the extrapolation factor for BPL systems, and (3) the existing slant-range method as it pertains to the effective field attenuation rate in a horizontal distance context. The Commission further requested submission of any other new empirical studies or information that may provide information regarding the BPL distance attenuation extrapolation factor. The Commission stated that its goal in this review is to provide BPL measurement procedures that will adequately ensure compliance with the Section 15.209 emissions standard for emissions at or below 30 MHz without placing unfair or undue compliance burdens on equipment manufacturers and users. In conducting this review, the Commission indicated that initially it continued to believe the existing 40 dB/decade extrapolation factor, in conjunction with the slant-range distance method, was reasonable and appropriate for adjusting measurements of BPL emissions on frequencies below 30 MHz.

42. The Commission also recognized that there is considerable variability around the 40 dB/decade value at different sites. The result of this variability is that the actual attenuation at some sites could be less than 40 dB/decade and using the current extrapolation factor at such sites could produce an adjusted measurement that would be less than the level that would be measured at the standard 30-meter measurement distance specified in § 15.209 of the Commission's rules. The Commission therefore requested comment on whether it would be desirable to modify the value of the BPL extrapolation factor to be 30 dB/decade or some other value. It observed that extrapolated emission levels based on a 30 dB/decade extrapolation factor when applied to slant distance would be comparable to the extrapolated emission levels based on a 20 dB/decade extrapolation factor applied to horizontal (lateral) distance. Recognizing that reliance on a 30 dB/

decade extrapolation factor could increase the compliance burden for BPL equipment and systems that are tested at locations where the attenuation rate is in fact in the range of 40 dB/decade or greater, the Commission clarified that in all cases, measurements of Access BPL equipment and systems will be allowed to be made at the 30-meters distance specified in § 15.209 of the Commission's rules and that where possible, the Commission's staff will make measurements at this distance when testing for compliance.

43. After consideration of the most recent information and comments on this matter and further deliberation on all of the studies and information in the record, the Commission has decided to retain the 40 dB/decade extrapolation factor for frequencies below 30 MHz. There are several reasons that lead us to this conclusion. Initially, the Commission observed that the 40 dB/decade extrapolation for frequencies below 30 MHz has served successfully in our program to control emissions from radio frequency devices for many years. It also observed that, while ARRL contends that 20 dB is the only scientifically correct and valid value for an extrapolation factor, the studies and information before us shows considerable differences in extrapolation factors under various powerline system configurations and usage conditions. The Commission concludes that there is no single "correct" value for an extrapolation for RF emissions from power lines, and instead find that the compelling and reasonable solution is to use the existing part 15 extrapolation factor that both has a scientific basis and has stood the test of time for a wide variety of devices and systems. It also notes that, using the slant range method in performing measurements has the effect of reducing the extrapolation factor to approximately 20 dB. The Commission considers too, that the extrapolation factor used with BPL measurements is only one element in a comprehensive set of rules that are designed and intended to minimize the risk of harmful interference from BPL operations and to put in place appropriate measures to eliminate such interference if it should occur. In that context, the rules require that harmful interference be corrected under any circumstances. Measurements for examination of compliance are important, to be sure, but interference must be corrected even if measurements indicate that the BPL operations at the site are compliant. While ARRL asserts that an extrapolation factor that is too

lax will lead to widespread instances of harmful interference that should be corrected *ex ante* as opposed to *ex post*, it has seen little evidence of harmful interference being caused under the rules as adopted with a 40-dB extrapolation factor.

44. In addition, the Commission notes that there is no support from any of the commenting parties that modifying the extrapolation factor to 30 dB/decade in order to take a more conservative approach that would compensate for the variability in the attenuation rate would provide a more appropriate extrapolation factor. Therefore, it is not adopting that change. To provide clarity for those conducting measurements for compliance of Access BPL equipment and systems with § 15.209 of the Commission's rules emissions standards, the Commission specifies the extrapolated values of compliant emissions levels at 3-meter and 10-meter horizontal (lateral) distance from the nearest point of the overhead power line carrying the BPL signals for typical heights of medium voltage power lines in the BPL measurement guidelines. The Commission is also adopting its proposal for a new method for determination of site specific extrapolation factors in measurements of emissions from BPL systems.

45. Looking more closely at this issue, the Commission finds that ARRL has not provided convincing information that the value of the measurement distance extrapolation factor for Access BPL should be reduced from 40 dB/decade to 20 dB/decade or some other number close to that value. While ARRL offers detailed and lengthy submissions of information on propagation of RF energy below 30 MHz and critiques of the studies, analyses and information provided by others, including this Commission, that information does not provide any new insights on radio propagation that would alter our decision. Moreover, its arguments for a 40 dB/decade standard do not account for two key factors that affect the significant attenuation of RF energy in this region of the spectrum: Factors in the emissions process (such as ground effects and the presence of multiple power lines and their position on the pole) and the significant variability in attenuation rate across different installation sites.

46. The Commission finds ARRL arguments to be unpersuasive. First, it is important to recognize that there is no "FCC-laboratory recommendation" as characterized by ARRL. The Commission is under no obligation to discuss in a rulemaking proceeding every staff observation or opinion

provided during the course of internal deliberations. It observes that the 20 dB/decade extrapolation factor was part of one of three options presented on slide #19. The presentation offered no specific analysis or measurement data supporting this extrapolation factor. Rather, as specified on the slide, the authors offered it as a way to postpone and/or reduce the interference potential of BPL systems. Additionally, as noted by Arkados and HomePlug, none of the five FCC staff presentations actually examined the path loss extrapolation factor, but rather, they examined other technical issues such as the effect of the distance down the power line, differences in radiated field strength due to the detector that was employed, effect of measurement receiver antenna height, audible interference and antenna polarization. The Commission therefore did not (and still do not) consider that the information on which the provided option on slide #19 was based to be sufficient or compelling such that it should override or supersede other information that we also considered in the extrapolation factor decision. As UTC observes, the staff presentations merely included a 20 dB/decade extrapolation factor as one option among many for regulating BPL operations in the HF bands; the presentations did not find that a 20-dB extrapolation factor represented the actual rate of decay, nor did they contain any underlying information or analysis that would support such a finding. Further, with respect to ARRL's assertions regarding our use of new studies in the *RFC/FNPRM* as *ex post facto* evidence, it apparently overlooks our quite specific statement therein that the decision to adopt the 40 dB/decade standard was based on information available at the time of the decision, not newly available information.

47. With regard to the new studies identified in the *RFC/FNPRM*, ARRL contends that the major flaw in the *NTIA Phase 2 Study* is that the modeling used does not fully account for the way that field strength decays at angles other than 90 degrees. ARRL further argues that with respect to height, the report errs in its attempted justification of the 5 dB height correction above 30 MHz but not below, and it justifies 40 dB/decade by disregarding 20 percent of the data points. On the other hand, CURRENT quotes the *NTIA Phase 2 Study* as stating: "[a]t or above 10 MHz, the simulation results show good agreement between the rate that field strength decays and the [40 dB/decade] distance extrapolation rate in the part 15 rules."

HomePlug also agrees that the *NTIA Phase 2 Study* clearly demonstrates that the 40 dB/decade extrapolation factor is the correct value at or above 10 MHz, and much closer below 10 MHz than figures used in the studies submitted by ARRL. The Commission observes that NTIA's modeling in its *Phase 2 Study* indicates that the field along a complex power line model is highly varied, with areas of greater and lesser field strength produced by cancellation and reinforcement effects. However, there are some regularities, including field strength maxima at multiples of wavelengths along the power line, which is the reason why the Commission adopted the requirement for measurements at multiple points along the power lines in our BPL measurement guidelines. In addition, as discussed above, ARRL's own modeling shows that the magnetic field (measured below 30 MHz) does not vary greatly with height. Further, the Commission agrees with NTIA's position that "the 80th percentile values eliminate the localized peaks that are unlikely to be encountered by a radio receiver randomly located in close proximity to an Access BPL power line." Thus, the Commission finds that the *NTIA Phase 2 Study* is not flawed as argued by ARRL.

48. The Commission recognizes the concerns of ARRL and IBEC regarding the *Brazil Study*. In addition, like the OFCOM studies before it, the *Brazil Study* would, in the best of circumstances provide only anecdotal information on the attenuation rate of BPL emissions as it only conducted measurements at a single location, rather than the very large number of sites that would be needed to develop a generalized description of that parameter. As it stated in the *RFC/FNPRM*, these studies do, however, provide an indication that BPL emissions tend to attenuate at rates that vary substantially across different sites, and that those rates can be much higher than the 20 dB/decade suggested by ARRL. In fact, the *Brazil Study*, while not individually probative, provides support for a much higher extrapolation factor than the similarly insubstantial OFCOM studies provided by ARRL.

49. The Commission agrees with ARRL that emissions radiating upwards from overhead power lines are likely to attenuate at lower rates than emissions radiating horizontally and lower to the ground. In cases where an amateur antenna is located on a tower above the height of the power lines, as is typical of fixed amateur stations, we would expect that the level of any emissions received by that antenna might typically

be higher than emissions received by a similar antenna located below the height of the power lines, all other things the same, because the path to the tower-mounted antenna will be less affected by the ground. However, the Commission's Access BPL rules provide for protection of such antennas by the absolute application of the prohibition against causing harmful interference in § 15.5 of the rules. Also the Commission would generally expect that if a BPL installer sees a tower-mounted antenna, the installer would take steps to avoid interference to it before the system commences operation. In any case, for safety reasons, our rules provide for measurement of Access BPL systems from locations relatively close to the ground, where attenuation rates are likely to be higher, rather than at heights similar to power lines.

50. ARRL argues a number of technical points to support using the free-space (or near free-space) 20 dB/decade attenuation rate associated with line sources. Again, the Commission agrees with ARRL on all of these technical points of well-documented RF propagation theory. While it did not explain earlier decisions on Access BPL at the level of detail that involved mentioning these factors (and do not believe that it is routinely necessary to explain propagation considerations which are a matter of accepted electromagnetic physics theory), the Commission did consider them in its decision. In fact, they were an intrinsic element of our deliberations. As a result, the Commission included provisions in the Access BPL measurement guidelines for testing along the power lines at specified intervals where emissions would be expected to be highest. It also considered that ground absorption and other environmental effects present near the surface that limit RF propagation typically result in attenuation of emissions in the MF and HF bands at rates much higher than the 20 dB/decade free space model, especially at the 1 meter height specified in the Access BPL measurement guidelines.

51. ARRL contends it is illogical to conclude that, if a 20 dB/decade extrapolation is appropriate at 30.001 MHz, the extrapolation somehow suddenly jumps to 40 dB/decade at 29.999 MHz. While ARRL is correct with regard to the physics of this issue, as CURRENT observes, "regulation is often a matter of drawing bright lines through gray lines." The Commission commonly uses "bright line" standards in its rules to provide clarity, simplicity, predictability and ease of applicability. The "bright line" difference in the extrapolation factors for under and over

30 MHz is intended to provide clear guidance in a region of the spectrum where there is considerable variability in the predictability of results. The Commission continues to believe that the current "fixed line" or "bright-line" approach for the different extrapolation factors above and below 30 MHz is appropriate for practical and administrative purposes.

52. The arguments of ARRL and CURRENT concerning the technical validity of using 40 dB/decade as the extrapolation factor for measuring emissions on frequencies below 30 MHz demonstrate the complexity involved in describing and estimating field strengths in the near-field regions of emissions. ARRL is generally correct in its technical presentation of the theory of such fields, *i.e.*, that emissions decay in the reactive near field at a rate of 40 dB/decade within a distance of  $\lambda/2\pi$  from the source and then in the radiating near field out to  $2D^2/\lambda$  at a rate of 20 dB/decade. The very long lengths of typical power line segments therefore would not be expected to affect the decay rate of field strengths relative to reactive near field phenomena and therefore at distances greater than 10 meters all frequencies above 4.78 MHz will generally be outside the reactive near field boundary. However, ARRL's description of the behavior of fields also shows that while the attenuation rate in the radiating near field is generally on the order of 20 dB/decade (in the free-space or near free-space case), there are standing wave patterns and other phenomena that make predictions unreliable. In addition, when measuring relatively close to the ground (at the 1-meter height specified for measurements at frequencies below 30 MHz), the proximity to and variation of ground features and other conditions cause great variability in signal levels. ARRL recognizes these ground effects, but argues that licensed services should not be protected only at ground level and that to do this the extrapolation factor should take into account the normally encountered antenna height of the victim receiver. Given that BPL measurements will be made close to the ground for the safety and practical reasons indicated and the propagation characteristics that are likely to be present in ground environments, the Commission continues to believe that there is justification for presuming that the expected attenuation rate of measured emissions at frequencies below 30 MHz is greater than 20 dB/decade. It also agrees with ARRL that licensed services should be protected in all cases and in this regard, the regime

of rules we have established for Access BPL systems, provides that protection.

53. The Commission observes that none of the standards mentioned by ARRL apply to Access BPL equipment and the specific environments in which these devices operate. In particular, even though ARRL insists that the CISPR 18 standard does apply to BPL as it would apply to any source of RF noise, the Commission notes that CISPR has been working on the subject of an emission standard for BPL as far back as 2000 under CISPR Subcommittee G. The work to develop a standard specific to BPL has continued in CISPR Subcommittee I, however, this work has been recently reset to its preliminary stage due to the complex issues surrounding RF emissions at frequencies below 30 MHz, with signal attenuation being highly variable depending on the localized environment. Moreover, the Commission finds that the record in this proceeding has established a substantial body of information that supports the use of 40 dB/decade in conjunction with slant-range distance to adjust the emissions level for test results obtained in accordance with the measurement standards it adopted for Access BPL.

54. In addition, as discussed in the *RFC/FNPRM*, the slant-range distance method in the Access BPL measurement guidelines works with the 40 dB/decade factor to yield extrapolated emissions level values that have the effect of imposing a more conservative emissions standard than would be derived using the horizontal (lateral) distance from the nearest point of the overhead power line carrying the BPL signals. In this regard, at the relatively short distances at which Access BPL emissions are to be measured, *i.e.*, distances 30 meters or less, applying the slant-range measurement method in the extrapolation of the measurements effectively reduces the compliant emission levels for BPL systems with respect to the horizontal distance from the power line. This reduction results because at any given horizontal distance from the power line, the slant-range distance is longer than the horizontal distance. The relationship is one of basic plane geometry that occurs due to the height of the power line on which the BPL signal injector is installed. When extrapolated values at 40 dB per decade of slant-range distance are plotted against the horizontal distance, the effective extrapolated emission level curve more closely follows the emission level curve based on a 20 dB per decade extrapolation factor at horizontal distances than the emission level curve based on a 40 dB per decade

extrapolation factor at horizontal distances. NTIA's modeling results in its *Phase 2 Study* effectively reflect this observation. Also, given that the Access BPL measurement guidelines require compliance measurements to be taken at 30 meters or less, the effect of the slant-range distance provision is significant at all distances where the extrapolation factor can be used.

55. ARRL and several of the commenting parties addressed the Commission's request for comment on whether it would be desirable to modify the extrapolation factor to be 30 dB/decade or some other value to account for the considerable variability around the 40 dB/decade expected attenuation value at different sites. It was our intent that this lower value would apply a more conservative approach that would compensate for those cases where the actual attenuation is less than 40 dB. In opposing this plan, ARRL asserts that the Commission is not apparently convinced by its own *ex post* argument justifying use of 40 dB/decade, as it immediately thereafter abandoned that argument and proposed instead to adopt an equally unjustified 30 dB/decade extrapolation factor in what appears to be the "King Solomon" approach rather than a real scientific analysis. ARRL rejects the approach underlying the 30 dB/decade proposal and argues that the Commission is obligated to adopt a scientifically valid extrapolation standard, which it contends is 20 dB/decade. The UTC and CURRENT also oppose such a change, stating that the Commission was correct to select 40 dB/decade as the distance extrapolation and that it should maintain that value. UPLC argues that a 30 dB/decade value would be inappropriate and that a reduced value would impose a significant compliance burden on Access BPL systems. CURRENT argues that the Commission's original selection of 40 dB/decade is well supported by the record and that the mere possibility of other supportable conclusions, especially if based on other studies, does not warrant a change. CURRENT and the UTC further submit that the now-demonstrable lack of interference reports from CURRENT's extensive operations supports not changing the extrapolation standard.

56. It is plain from the record that reducing the extrapolation factor to the more conservative 30 dB/decade level to compensate for those situations in which the actual attenuation is less than 40 dB/decade would not satisfy the concerns of any of the parties to this matter or otherwise provide any benefits that would improve our Access BPL measurement guidelines. Contrary to

ARRL's misapprehension, our consideration of a reduction in the extrapolation factor was not intended as a "compromise" approach in consideration of the wide variations in the studies and data before us. Rather, it was a recognition of the uncertainty or inexactness inherent in the information available and the amount of analysis undertaken at the time, and a signal of our openness in reconsidering the issue in that light.

57. Taking into consideration the above evaluations and all of the additional information before us now, the Commission believes that the most compelling path points to retaining the 40 dB extrapolation factor. In this regard, it first observed that it used this extrapolation value successfully with measurements at frequencies below 30 MHz in its program to control emissions from radio frequency devices for many years. This includes not only consumer products, but also industrial, scientific and medical equipment that may use thousands of watts of power and couple radio noise onto power lines that can radiate for significant distances. In addition, while ARRL asserts that there is only one scientifically correct and valid answer of an extrapolation factor of 20 dB, the studies and information before us show considerable differences in extrapolation factors under various system configurations and usage condition. The Commission concludes that there is no single "right" value for the extrapolation factor that accurately reflects environmental conditions in all cases, and instead finds that the most appropriate decision is to use the existing value in the rules that both has a scientific basis and has stood the test of time for a wide variety of devices and systems. The Commission also considers that, as observed in the discussions, using the slant range to perform measurements has the effect of reducing the extrapolation factor to approximately 20 dB. In addition, the attenuation factors that are typically present when making measurements close to the ground, as specified in the BPL rules, tend to increase the signal loss above that which occurs from the spreading of energy in free space propagation. Finally, while one can debate the propriety and scientific validity of any particular extrapolation factor, the Commission must consider that the extrapolation factor is but one element in the context of an overall set of rules that are designed to minimize the risk of harmful interference and to put in place appropriate measures to eliminate such interference if it should occur. Whether the extrapolation factor

is 20 dB or 40 dB or somewhere in between is far less important than the fact that harmful interference must be corrected under any circumstances. While ARRL asserts that an extrapolation factor that is too lax will lead to widespread instances of harmful interference that should be corrected *ex ante* as opposed to *ex post*, the Commission has seen little evidence of harmful interference being caused. Accordingly, the Commission will not modify the extrapolation factor for the emissions standard for frequencies below 30 MHz to compensate for the variability in the field strength attenuation rate at different locations.

58. The Commission also reiterates here the clarification it issued in the *RFC/FNPRM* that measurements of BPL equipment and systems should be made at the 30-meters distance specified in § 15.209 of the Commission's rules unless circumstances such as high ambient noise levels or geographic limitations are present, in which case, a 3-meter or 10-meter horizontal distances indicated in the BPL measurement guidelines may be used. The Commission further clarifies that measurements made at the 30-meter distance specified in the § 15.209 of the Commission's rules emissions standard will prevail over measurements made at shorter distances and that where possible and practical, the Commission's staff will make measurements at this distance when testing for compliance. As indicated, to provide additional clarity in our compliance requirements, the Commission also amended the BPL measurement guidelines to specify the extrapolated values of the emissions level for compliance at 3-meter and 10-meter horizontal distances from the nearest point of the overhead power line carrying the BPL signals for typical heights of medium voltage power lines. These clarifications of the existing rules as well as the adoption of the definition for slant-range distance would assist the industry in ensuring compliance of BPL systems without imposing additional regulatory costs.

#### Site-Specific Extrapolation Factors

59. In the *RFC/FNPRM*, the Commission proposed to allow parties testing BPL systems for compliance with the radiated emissions limits to determine distance correction factors on a site-by-site basis using a new *in situ* measurement procedure designed specifically for Access BPL. This plan, which was based on a concept under consideration in the IEEE Working Group P1775/D2 effort at that time and which has been finalized since, would

allow entities conducting measurements of Access BPL systems and equipment to determine an extrapolation factor specific to a site by fitting a straight line to measurements of field strength in dB $\mu$ V/m vs. logarithmic distance in meters from the nearest conductor carrying BPL emissions, where the extrapolation factor would be taken as the slope of that line. The Commission indicated that the site-specific extrapolation factor would be an alternative to the extrapolation factor specified in the BPL measurement guidelines and would be replacing the existing method using only two data points for determining site-specific extrapolation factors currently in the rules. The proposed alternative method would only be applicable to Access BPL devices operating on frequencies below 30 MHz.

60. Under the proposal in the *RFC/FNPRM*, entities conducting measurements would determine an extrapolation factor specific to the site by fitting a straight line to measurements of field strength in dB $\mu$ V/m vs. logarithmic distance in meters from the nearest conductor carrying BPL emissions, where the extrapolation factor would be taken as ten times the slope,  $n$ , of that line. The slope  $n$  any point on the straight line in  $\mu$ V/m would be:

$$(20\log E_r - 20\log E_2) / (10\log D_2 - 10\log D_r)$$

where  $E_r$  is the measured field strength at distance  $D_r$ .

The field strength in dB $\mu$ V/m at any distance  $D$  along the best straight line fit is estimated from the value of  $n$  as:

$$20\log E_r = 20\log E_2 + n(10\log D_2 - 10\log D_r)$$

The extrapolation factor would be derived from a best straight line fit determined by a linear least squares regression calculation from measurements made at four or more lateral distances from the overhead line, starting at no less than 6 meters from the lateral plane and spaced from each other by at least 3 meters. If these measurements allow a straight line with a negative slope to be calculated or drawn with reasonable fit (the minimum regression coefficient of multiple correlation would be 0.9), the best straight line fit would be used to calculate field strength at the 30-meters standard measurement distance in the rules according to the equation above. If the four measurements do not fall near any straight line or negative slope, measurements at a new distance would be added until a reasonable fit to a straight line is indicated. In addition, measurements that obviously show a

“null” or other “outlier” value would be ignored. Parties employing site-specific extrapolation values would be required to provide a record of the measurements under the above procedure and to submit those measurements and their derivation of the *in situ* values with any measurements with compliance submissions to the Commission.

61. The Commission continues to believe the availability of a site-specific approach for determining values for extrapolation of measurements of Access BPL emissions on frequencies below 30 MHz is a desirable and useful alternative to the fixed extrapolation factor. The option to use site-specific values can substantially alleviate the measurement concerns associated with the standard extrapolation factor and the variability in attenuation rates that may be observed in the field, and particularly where measurements at a site may plainly not appear to conform to the 40 dB/decade standard. It also recognizes ARRL's concerns that a site-specific option could be abused by careful selection of measurement points. However, the Commission finds that the proposed approach that requires four measurements spaced at least 3 meters apart with provisions for additional measurements where a straight line with a negative slope is not approximated by the four initial measurements, is sufficient to develop a reliable indication of the attenuation rate at a site. In particular, it believes the requirement in this new procedure that the measurements used to develop the extrapolation value approximate a straight line with a negative slope as determined through the linear least squares regression method (with a minimum regression coefficient of multiple correlation of 0.9) will adequately guard against the “cherry picking” concern mentioned by ARRL. Where such a line cannot be approximated, the Commission will also require that measurements be made at a different perpendicular position along the power line very nearby or at the same perpendicular position but on the opposite side of the line from the first set of measurements.

62. This new site-specific procedure will replace the existing § 15.31(f)(2) of the Commission's rules alternative for Access BPL that only requires two measurements. This plan conforms substantially to the IEEE P1775–2010 standard which has been developed. The Commission observes that a straight line best fit of multiple data points using the least squares regression technique is not a new idea developed by the IEEE standard, it is a well-established and commonly used

statistical method. It notes that in the *RFC/FNPRM*, it proposed to derive the extrapolation factor from a best straight line fit determined by a linear least squares regression calculation from measurements made at four or more lateral distances from the overhead line, starting at no less than 6 meters from the lateral plane and spaced from each other by at least 3 meters; at that time, the IEEE standard was in a state of transition and we were merely proposing a measurement concept. The Commission now observes the IEEE P1775–2010 has finalized its standard to specify that measurements be made at four or more lateral distances from the overhead line, starting at no less than 3 meters from the lateral plane and spaced from each other by at least 3 meters. The Commission adopted the distances as specified in the IEEE published standard for the new site-specific measurement procedure. This procedure is an improvement over the current procedure for determining site-specific extrapolation factors in § 15.31(f)(2) of the Commission's rules, which requires only two measurement points without any specific separation distance. The Commission cautions parties responsible for certification measurements to bear in mind that the objective of the site-specific procedure is to plot enough data points to draw a valid extrapolation curve; accordingly, in some situations the number of measurement points may need to exceed the recommended minimum for the resulting extrapolation to be valid. Further, as stated in the *BPL Order* and the *BPL Reconsideration Order*, operators of Access BPL systems are responsible for eliminating any harmful interference that may occur or must cease operation upon notification by a Commission representative that the device is causing harmful interference. Accordingly, the Commission amended its rules as set forth in Appendix C of this Order to establish a new method for determining site-specific extrapolation values for Access BPL measurements as described herein. Because this is an alternative method intended to facilitate compliance measurements which may be used at the BPL operator's discretion, the requirement provides benefits without imposing additional regulatory costs. The benefits of having this additional method would enable BPL operators to better adjust the operating parameters of BPL devices according to specific installation sites that might not conform to the standard extrapolation value, which could lead to cost savings and reduced interference potential. Additional provisions of this procedure

are set forth in the revised Access BPL measurement guidelines in Appendix D of the Order.

63. The Commission will not allow the site-specific procedure to be used at locations within 30 meters of a power pole with a ground conductor where the Access BPL signals devices are carried on a neutral/grounded line of the power system. In this regard, it is concerned that emissions from a grounding conductor mounted on the side of a power line pole could combine with the emissions from the overhead neutral power line to produce false indications of the attenuation rate that would distort the slope of the extrapolation curve. Accordingly, the Commission amended its rules as set forth in Appendix C to establish a new method for determining site-specific extrapolation values for Access BPL measurements as described herein. Additional provisions of this procedure are set forth in the revised Access BPL measurement guidelines in Appendix D of the Order.

#### The Access BPL Database

64. ARRL contends that the BPL database is virtually useless due to errors, omissions and listings of systems that are not operating any longer and systems that have never been placed in operation. It cites as an example an incident in which it sent an email message to the person listed in the database for the Manassas, VA, BPL system, it found the email contact was invalid and follow-up email messages to the City of Manassas went unanswered. In its reply comments, the City of Manassas submits that when the system operator, Comtek, transferred operation of the system to the city, the contact was not updated immediately but the error was corrected promptly in April 2009 when the city was notified by ARRL that the listing was incorrect. The Commission agrees with ARRL that the database should be maintained with accurate, up-to-date information. The Commission's staff contacted the database manager, UTC, about ARRL's concerns and in its reply comments, UTC affirms that the database has been and is being reviewed periodically to ensure that the information is currently accurate. The Commission does note that while it is important that the database be up-to-date in all respects, it is most important that operating and soon-to-be operating systems not be omitted and it does not have information that such systems were not or are not listed. The Commission therefore encourages UTC to continue to be diligent in its management of the database and other interested parties to work with UTC in providing

information to ensure that the records in the database are accurate and up-to-date.

#### Final Regulatory Flexibility Analysis

65. As required by the Regulatory Flexibility Act (RFA),<sup>1</sup> an Initial Regulatory Flexibility Analysis (IRFA) was incorporated in the *Request for Comment and Further Notice of Proposed Rulemaking (RFC/FNPRM)* in ET Docket Nos. 04–37 and 03–104.<sup>2</sup> The Commission sought written public comment on the proposals in the *RFC/FNPRM*, including comment on the IRFA. This present Final Regulatory Flexibility Analysis (FRFA) conforms to the RFA.

#### A. Need for, and Objectives of, the Second Report and Order

66. The Second Report and Order maintains the existing Access BPL emissions standards and other technical operation rules, as well as the existing extrapolation 40 dB/decade factor prescribed in the rules for use in measurement of emissions from Access BPL systems. In addition, the Second Report and Order modifies the rules to (1) Require a deeper notch filter depth when a notch filter is used to avoid interference to a specific frequency band; (2) adopt a definition for the slant-range distance used in the BPL measurement guidelines to further clarify its application; and (3) establish a new procedure for determining site-specific extrapolation factors.

67. The decisions in the Second Report and Order are consistent with the mandate by the United States Court of Appeals for the District of Columbia in *ARRL v. FCC*, and will provide regulatory certainty for both manufacturers of Access BPL equipment and systems operators so that development of equipment and construction of facilities can proceed unimpeded by any concerns about the status of the regulations with which equipment and systems must comply.<sup>3</sup>

<sup>1</sup> See 5 U.S.C. 603. The RFA, see 5 U.S.C. 601–612, has been amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), Public Law 104–121, Title II, 110 Stat. 857 (1996), and the Small Business Jobs Act of 2010, Public Law 111–240, 124 Stat. 2504 (2010).

<sup>2</sup> *Request for Further Comment and Further Notice of Proposed Rulemaking* in ET Dockets No. 04–37 and 03–104 (*Amendment of Part 15 Regarding New Requirements and Measurement Guidelines for Access Broadband Over Power Line Systems, Carrier Current Systems*), 24 FCC Rcd 9669 (2009) (RFC/FNPRM).

<sup>3</sup> See *American Radio Relay League, Incorporated, v. Federal Communications Commission (ARRL v. FCC)*, 524 F.3d 227 (D.C. Cir. 2008).

*B. Statement of Significant Issues Raised by Public Comments in Response to the IRFA*

68. There were no public comments filed that specifically addressed the rules and policies proposed in the IRFA.

*C. Response to Comments by the Chief Counsel for Advocacy of the Small Business Administration*

69. Pursuant to the Small Business Jobs Act of 2010, the Commission is required to respond to any comments filed by the Chief Counsel for Advocacy of the Small Business Administration, and to provide a detailed statement of any change made to the proposed rules as a result of those comments. The Chief Counsel did not file any comments in response to the proposed rules in this proceeding.

*D. Description and Estimate of the Number of Small Entities to Which the Rules Will Apply*

70. The RFA directs agencies to provide a description of, and, where feasible, an estimate of the number of small entities that may be affected by the proposed rules, if adopted.<sup>4</sup> The RFA defines the term “small entity” as having the same meaning as the terms “small business,” “small organization,” and “small business concern” under Section 3 of the Small Business Act.<sup>5</sup> Under the Small Business Act, a “small business concern” is one that: (1) Is independently owned and operated; (2) is not dominant in its field of operations; and (3) meets any additional criteria established by the Small Business Administration (SBA).<sup>6</sup>

71. Nationwide, there are a total of approximately 27.5 million small businesses, according to the SBA.<sup>7</sup> A “small organization” is generally “any not-for-profit enterprise which is independently owned and operated and is not dominant in its field.”<sup>8</sup> Nationwide, as of 2002, there were approximately 1.6 million small organizations.<sup>9</sup> The term “small governmental jurisdiction” is defined generally as “governments of cities, towns, townships, villages, school districts, or special districts, with a population of less than fifty thousand.”<sup>10</sup> Census Bureau data for 2002 indicate that there were 87,525

local governmental jurisdictions in the United States.<sup>11</sup> We estimate that, of this total, 84,377 entities were “small governmental jurisdictions.”<sup>12</sup> Thus, we estimate that most governmental jurisdictions are small.

72. The adopted rules pertain to manufacturers of unlicensed communications devices. The appropriate small business size standard is that which the SBA has established for radio and television broadcasting and wireless communications equipment manufacturing. The Census Bureau defines this category as follows: “This industry comprises establishments primarily engaged in manufacturing radio and television broadcast and wireless communications equipment. Examples of products made by these establishments are: Transmitting and receiving antennas, cable television equipment, GPS equipment, pagers, cellular phones, mobile communications equipment, and radio and television studio and broadcasting equipment.”<sup>13</sup> The SBA has developed a small business size standard for firms in this category, which is: All such firms having 750 or fewer employees.<sup>14</sup> According to Census Bureau data for 2007, there were a total of 939 establishments in this category that operated for part or all of the entire year. Of this total, 784 had less than 500 employees and 155 had more than 100 employees.<sup>15</sup> Thus, under this size standard, the majority of firms can be considered small.

*E. Description of Projected Reporting, Recordkeeping and Other Compliance Requirements*

73. The Second Report and Order does not contain new or modified information collection requirements. The minor modified technical requirements adopted in this Second Report and Order, as discussed below, do not impose significant burden and will not have a significant economic

impact on a substantial number of small entities that are, or may be, subject to the requirements of the rules in the item.

*F. Steps taken To Minimize Significant Economic Impact on Small Entities and Significant Alternatives Considered*

74. The RFA requires an agency to describe any significant alternatives that it has considered in reaching its proposed approach, which may include the following four alternatives (among others): (1) The establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance or reporting requirements under the rule for small entities; (3) the use of performance, rather than design, standards; and (4) an exemption from coverage of the rule, or any part thereof, for small entities.

75. In this Second Report and Order, we modify our rules and measurement procedures for Access BPL devices operating below 30 MHz to (1) Require a deeper notch filter depth when a notch filter is used to avoid interference to a specific frequency band; (2) establish a new procedure for determining site-specific extrapolation factors; and (3) adopt a definition for the slant-range distance used in the BPL measurement guidelines to further clarify its application. In reviewing the requirement for a 20-dB notching capability and current developments in BPL equipment, we now find that it would be appropriate to increase the required notching capability of Access BPL systems operating below 30 MHz to 25 dB from the existing requirement of 20 dB, when a notch filter is used to avoid interference to a specific frequency band. This deeper notching capability is technologically available and voluntarily implemented in the field by Access BPL operators to avoid potential interference to amateur radio operators; therefore, the new requirement would not pose a substantial burden on Access BPL manufacturers. To afford manufacturers time to redesign their equipment to comply with the new, more conservative 25-dB notching requirement, we are allowing an 18-month period from the date this action is published in the **Federal Register** before the requirement becomes effective.

76. The Commission further established an alternative method to allow parties testing BPL systems for compliance with the radiated emissions limits to determine distance correction

<sup>11</sup> U.S. Census Bureau, Statistical Abstract of the United States: 2006, Section 8, page 272, Table 415.

<sup>12</sup> We assume that the villages, school districts, and special districts are small, and total 48,558. See U.S. Census Bureau, Statistical Abstract of the United States: 2006, section 8, page 273, Table 417. For 2002, Census Bureau data indicate that the total number of county, municipal, and township governments nationwide was 38,967, of which 35,819 were small. *Id.*

<sup>13</sup> U.S. Census Bureau, 2007 NAICS Definitions, “334220 Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing”; <http://www.census.gov/naics/2007/def/ND334220.HTM#N334220>.

<sup>14</sup> 13 CFR 121.201, NAICS code 334220.

<sup>15</sup> [http://factfinder.census.gov/servlet/IBQTable?\\_bm=y&-fds\\_name=EC0700A1&-geo\\_id=&-skip=300&-ds\\_name=EC0731SG2&-lang=en](http://factfinder.census.gov/servlet/IBQTable?_bm=y&-fds_name=EC0700A1&-geo_id=&-skip=300&-ds_name=EC0731SG2&-lang=en).

<sup>4</sup> See 5 U.S.C. 603(b)(3).

<sup>5</sup> *Id.* 601(3).

<sup>6</sup> *Id.* 632.

<sup>7</sup> See SBA, Office of Advocacy, “Frequently Asked Questions,” <http://www.sba.gov/advo/stats/sbfaq.pdf> (accessed Dec. 2010).

<sup>8</sup> 5 U.S.C. 601(4).

<sup>9</sup> Independent Sector, *The New Nonprofit Almanac & Desk Reference* (2002).

<sup>10</sup> 5 U.S.C. 601(5).

factors on a site-by-site basis using an *in situ* measurement procedure when measurements cannot be made at the reference measurement distance of 30 meters as specified in the rules. Because this is an alternative method intended to facilitate compliance measurements which may be used at the BPL operator's discretion, the requirement provides benefits without imposing additional regulatory costs. The benefits of having this additional method would enable BPL operators to better adjust the operating parameters of BPL devices according to specific installation sites that might not conform to the standard extrapolation value, which could lead to cost savings and reduced interference potential.

77. In addition, the Commission clarify that parties testing BPL equipment and systems for compliance with emissions limits in our rules should measure at the standard reference 30-meter distance whenever possible, and only measure at the shorter distances recommended in the BPL measurement guidelines if safety or ambient conditions require taking measurements at a closer distance such as 10 meters or 3 meters from the overhead line. The Commission also adopts a definition for the slant-range distance used in the BPL measurement guidelines to further clarify its application. The Commission also modified its BPL measurement guidelines to provide clarity for those conducting measurements for compliance of Access BPL equipment and systems with the § 15.209 of the Commission's rules emissions standards by specifying the extrapolated values of compliant emissions levels at 3-meter and 10-meter horizontal (lateral) distance from the nearest point of the overhead power line carrying the BPL

signals, for typical heights of medium voltage power lines. These clarifications of the existing rules as well as the adoption of the definition for slant-range distance would assist the industry in ensuring compliance of BPL systems, promoting possible cost savings without imposing additional regulatory costs.

#### Report to Congress

78. The Commission will send a copy of the Second Report and Order, including this FRFA, in a report to be sent to Congress pursuant to the Congressional Review Act.<sup>16</sup> In addition, the Commission will send a copy of the Second Report and Order, including this FRFA, to the Chief Counsel for Advocacy of the SBA.<sup>17</sup>

79. *Congressional Review Act.* The Commission will send a copy of this Second Report and Order in a report to be sent to Congress and the Government Accountability Office pursuant to the Congressional Review Act, *see* 5 U.S.C. 801(a)(1)(A).

#### Ordering Clauses

80. Pursuant to the authority contained in sections 4(i), 301, 302, 303(e), 303(f) and 303(r) of the Communications Act of 1934, as amended, 47 U.S.C. 154(i), 301, 302, 303(e), 303(f) and 303(r), this Second Report and Order is hereby *Adopted* and part 15 of the Commission's Rules *Are Amended* as set forth in Final Rules effective December 21, 2011.

#### List of Subjects in 47 CFR Part 15

Communications equipment, Radio.

<sup>16</sup> See 5 U.S.C. 801(a)(1)(A).

<sup>17</sup> See 5 U.S.C. 604(b).

Federal Communications Commission.

**Marlene H. Dortch,**  
*Secretary.*

#### Final Rules

For the reasons discussed in the preamble, the Federal Communications Commission amends 47 CFR part 15 to read as follows:

#### PART 15—RADIO FREQUENCY DEVICES

■ 1. The authority citation for part 15 continues to read as follows:

**Authority:** 47 U.S.C. 154, 302a, 303, 304, 307, 336, 544a and 549.

■ 2. Section 15.3 is amended by adding paragraph (hh) to read as follows:

#### § 15.3 Definitions.

\* \* \* \* \*

(hh) *Slant-Range Distance.* Diagonal distance measured from the center of the measurement antenna to the nearest point of the overhead power line carrying the Access BPL signal being measured. This distance is equal to the hypotenuse of the right triangle as calculated in the formula below. The slant-range distance shall be calculated as follows:

$$d_{slant} = \sqrt{(h_{pwr\_line} - h_{ant})^2 + (d_h)^2}$$

Where:

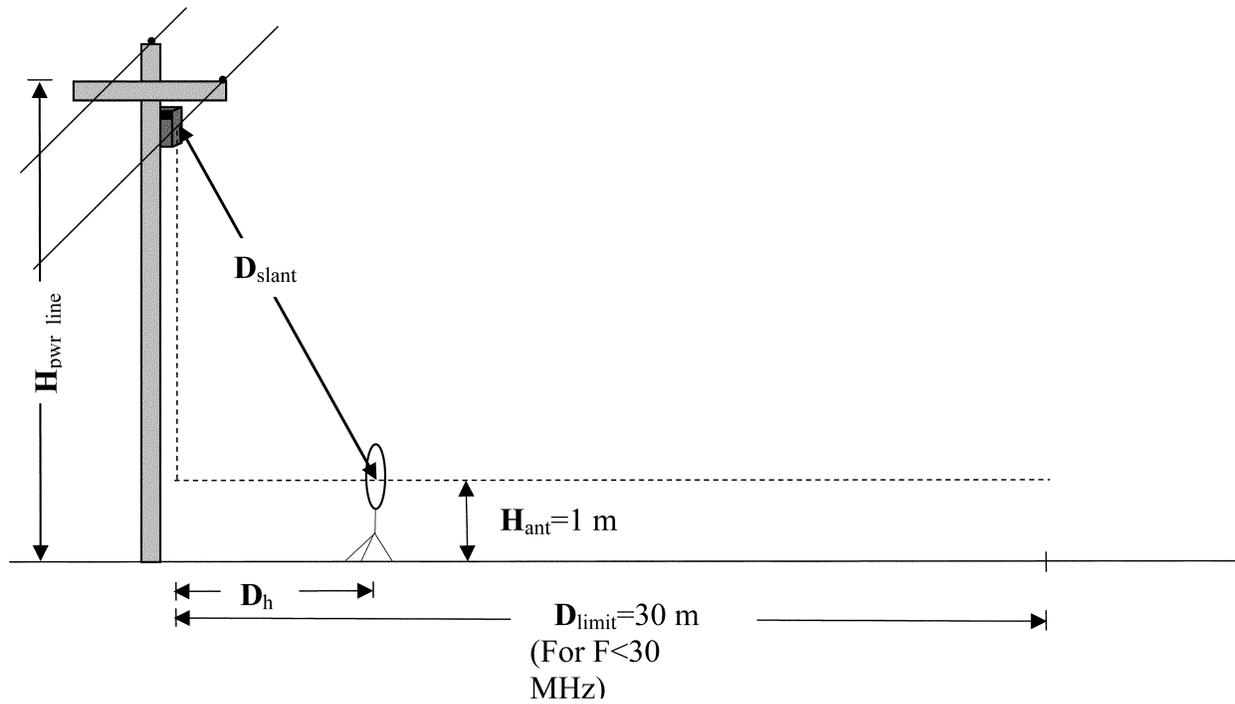
$d_{slant}$  is the slant-range distance, in meters (see Figure 1, below);

$d_h$  is the horizontal (lateral) distance between the center of the measurement antenna and the vertical projection of the overhead power line carrying the BPL signals down to the height of the measurement antenna, in meters;

$h_{pwr\_line}$  is the height of the power line, in meters; and

$h_{ant}$  is the measurement antenna height, in meters.

Figure 1 – Illustration of Slant-Range Distance



$D_{slant}$  is the slant-range distance, in meters;  
 $D_h$  is the horizontal (lateral) distance between the center of the measurement antenna and the vertical projection of the overhead power line carrying the BPL signals down to the height of the measurement antenna, in meters;  
 $D_{limit}$  is the distance at which the emission limit is specified in Part 15 (e.g., 30 meters for frequencies below 30 MHz);  
 $H_{pwr\_line}$  is the height of the power line, in meters; and  
 $H_{ant}$  is the measurement antenna height, in meters.

■ 3. Section 15.31 is amended by adding a sentence at the end of paragraph (f)(2), by redesignating paragraphs (f)(3) through (f)(5) as (f)(4) through (f)(6), and by adding a new paragraph (f)(3) to read as follows:

**§ 15.31 Measurement standards.**

\* \* \* \* \*

(f) \* \* \*

(2) \* \* \* This paragraph (f) shall not apply to Access BPL devices operating below 30 MHz.

(3) For Access BPL devices operating below 30 MHz, measurements shall be performed at the 30-meter reference distance specified in the regulations whenever possible. Measurements may be performed at a distance closer than that specified in the regulations if circumstances such as high ambient noise levels or geographic limitations are present. When performing

measurements at a distance which is closer than specified, the field strength results shall be extrapolated to the specified distance by using the square of an inverse linear distance extrapolation factor (i.e., 40 dB/decade) in conjunction with the slant-range distance defined in § 15.3(hh) of this part. As an alternative, a site-specific extrapolation factor derived from a straight line best fit of measurements of field strength in  $\text{dB}\mu\text{V}/\text{m}$  vs. logarithmic distance in meters for each carrier frequency, as determined by a linear least squares regression calculation from measurements for at least four distances from the power line, may be used. Compliance measurements for Access BPL and the use of site-specific extrapolation factors shall be made in accordance with the Measurement Guidelines for Access BPL systems specified by the Commission. Site-specific determination of the distance extrapolation factor shall not be used at locations where a ground conductor is present within 30 meters if the Access BPL signals are on the neutral/grounded line of a power system.

\* \* \* \* \*

■ 4. Section 15.37 is amended by adding paragraph (o) to read as follows:

**§ 15.37 Transition provisions for compliance with the rules.**

\* \* \* \* \*

(o) All Access BPL devices operating below 30 MHz that are manufactured, imported, marketed or installed on or after May 21, 2013 shall comply with the requirements specified in § 15.611(c)(1)(i) of this part.

■ 5. Section 15.611 is amended by revising paragraph (c)(1)(i) to read as follows:

**§ 15.611 General technical requirements.**

\* \* \* \* \*

(c) \* \* \*

(1) \* \* \*

(i) For frequencies below 30 MHz, when a notch filter is used to avoid interference to a specific frequency band, the Access BPL system shall be capable of attenuating emissions within that band to a level at least 25 dB below the applicable Part 15 limits.

\* \* \* \* \*

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