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

In the Matter of	)	
	)	
Amendment of Part 15 regarding new requirements and measurement guidelines for Access Broadband over Power Line Systems	)	**ET Docket No. 04-29**
	)	

Via the ECFS

COMMENTS on the Notice of Proposed Rulemaking
by Leonard H. Anderson

I wish to thank the Commission for providing a forum for commentary by all citizens. Please allow me to state that I am a retired electronics design engineer with no vested interest in any professional or amateur radio activity or educational institution nor communications service provider nor any of those who have commented on this docket's subject. All of the following comments are those of a private citizen fortunate to experience a half century in the radio-electronics industry and military of the United States.

On the Naivite of the Concept of Electric Power Lines as Broadband Transmission Lines

As an engineer in the radio frequencies (RF) I find the Commissioners' statements surprisingly naive technically and theoretically.[1] While there certainly exist hundreds of thousands of kilometers of primary electric power distribution lines all throughout the nation...and that these electric power lines serve very well in distribution of 60 Hertz alternating current (AC)...they are ***not*** broadband *RF transmission lines.* Those electric power distribution lines were ***never designed to be such.***

RF transmission lines as commonly used may be one of two categories: TEM (Transverse Electro-Magnetic field) coaxial cable as used in community access closed-circuit television distribution; balanced line wire pair or wire pairs (as in telephone distribution cable). Coaxial cable (*coax*) keeps its TEM field confined to within the cable due to the (generally solid) outer conductor. The outer conductor may be connected to earth ground without upsetting the TEM field or any electrical characteristics within the coax. Pairs of wires are considered "balanced above ground" in that nothing in the electric-magnetic field is referenced to any earth ground or other common conductor. The electric-magnetic fields around a *balanced pair* is not confined and may induce or couple the signal field to another pair or another conductor in the near vicinity. The pairs of wires in a typical telephone distribution cable are individually twisted prior to bundling them into a cable to reduce cross-coupling from one pair to any other. Coaxial cable is referred to as *unbalanced* and does not

[1] Appendices to NPRM 04-29, pp 34-38.

couple any signal through the outer conductor unless that conductor has apertures.

Both unbalanced coax and balanced pairs have an essential quality termed *characteristic impedance*. Characteristic impedance is a complex subject. Suffice to say that a signal source and signal load must be *matched* to a transmission line's characteristic impedance in order to transfer the most power from source to load. Failure to match the line's impedance results in both a reduction in power transfer and the creation of *standing waves* on the line due to reflections of the signal back down the line. If there is a good match of all impedances, a transmission line can be considered very broadband; i.e., a wide range of frequencies of signals may propagate through the line.

Characteristic impedance of any transmission line is a function of many factors, chief of which are the conductor diameters (or other dimensions if not circular), conductor spacing, the dielectric material between conductors. Conductor material (such as copper, aluminum, etc.) will determine overall loss per unit length through finite conductor resistivity and *skin effect* at the higher frequencies.[2] Formulas describing the physical properties of transmission lines' characteristic impedance are well known in the RF industry and have been so for at least a half century.

Any change in physical dimensions of a transmission line, even from one line to another with both having the same characteristic impedance results in a *discontinuity*. Discontinuities can cause actual reflections of a propagated wave back to the source. Reflections cause standing waves and contribute to some line loss of signal power. In the case of a balanced line having a discontinuity on one wire as opposed to the other, the discontinuity upsets the balance of the pair and may cause some free space radiation of the propagating wave.[3]

Deliberate discontinuities are used in TEM field to enable certain components such as various filters or *directional couplers* to pass or block or couple waves at certain frequencies.[4] What must be noted is that

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2 Skin effect is an inverse function of frequency. At higher frequencies, current tends to flow in thinner and thinner areas of the conductor closest to an opposite conductor in the line. In coax cable this is the outer surface of the center conductor and the inner surface of the outer conductor. In balanced pairs it is towards the outer surfaces of both conductors. At 60 Hz AC electric power frequency skin effect may be entirely neglected, all losses due to conductor resistance.

3 The mathematical description of one-sided discontinuities' radiation from balanced pairs is rare in electronics literature and not normally considered in practical balanced pair transmission lines. In general, such lines are installed with a minimum of discontinuities or at least similar discontinuities (such as physical support wires or clamps on insulators) at the same length position along a line. Balanced pairs were common as the feedlines for High Frequency (HF) range radio transmitters of higher powers (up to 40 KW output in the commenter's experience 48 years ago). Convention in high power transmitters at VHF and UHF (30 to 3000 MHz) is to use large coaxial cable.

4 A good text on fields and waves utilizing deliberate discontinuities is *Microwave Filters, Impedance-Matching Networks and Coupling Structures* by George L. Matthaei, Leo Young, and E.M.T. Jones, McGraw-Hill Book Company, 1964, 1096 pages. That text includes many photographs as well as details of construction and response of filters and couplers, both for relatively narrowband and wideband passive components for frequency ranges at UHF and higher. The same physical principles apply to lower frequencies although the scaling in size for lower frequencies makes them too large for inclusion in practical system structures. In the case of BPL systems stretching for miles in size, the physical principles can apply directly. A directional coupler allows wave propagation in one direction while inhibiting propagation in the opposite direction.

such deliberate discontinuities are **contained within** the component and are seldom allowed to radiate.[5] A uniform-dimension TEM field transmission line, coaxial cable, is the present-day major conveyer of very broadband community access television distribution. Such broadband capability is exemplified by a typical frequency range of 10 to 900 MHz, a span greater than 6 octaves and may carry 200 or more television channels utilizing digital formatting of all channels' video and audio.[6] Radiation from a pole-mounted cable television system is minimal due to the inherent closed nature of the TEM field and a solid conductive surface of the coax outer conductor.[7]

Similarly, the telephone distribution cable has low radiation due to individual wire pairs being twisted in the cable bundle and from the cable's overall conductive sheath.[8] For utility pole mounting, telephone cables are at the lowest height in my area, television cable distribution about 2 meters higher. Electric power low voltage (115/220 VAC) local distribution above that by about the same distance, the pole tops carrying an open wire triad for 4.4 KiloVolt (KV) area electric power distribution. Pole-mounted transformers change the 4.4 KV AC to two-phase 115 VAC for about 20 residences per transformer. The *drop* or connection to individual subscriber residences is usually a twisted triad of heavy-gauge wire with a single steel line for support (not carrying any electric current). The electric power drop enters metallic conduit at the residence, that conduit being made to earth ground through a buried grounding rod.

The preceding description is typical of the San Fernando Valley section of Los Angeles, California, for older above-ground utility distribution.[9] Utility poles are approximately 11 meters in height. The 4.4 KV AC *high line* has wire spacings variable from 0.8 to about 1.2 meters depending on the pole location of a street with one 30 degree turn. After four decades since installation there are several in-line splices along the 4.4 KV

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[5] Exceptions include *slotted waveguide* antenna arrays and so-called *leaky coax* where the outer conductor has deliberate apertures to permit wave fields to exist outside of the coaxial cable. Such leaky coax is sometimes used for radio wave propagation at low strengths in the immediate vicinity of the cable. An example is tunnel underpasses to maintain vehicle communications within the tunnel.

[6] In modern community-access television distribution, coax cable is still used at the *tail end* of a cable system; i.e., closest to a group of subscribers. Major groups of subscribers in such systems use fiber-optic cable for group distribution towards the *head end* or origin of all signals. The *drop* to individual subscribers is still done with TEM field coaxial cable whether the format of the signal is digital or analog. That combination is a good compromise in equipment complexity versus increased signal-to-noise ratio and reduced overall signal attenuation. Cable television systems can carry a greater group of television channels than is permissible in free-space broadcasting (under pre-DTV regulations) due to a continuous frequency span in a closed system.

[7] Radiation limits are regulated by Part 76, Title 47 C.F.R.

[8] The original cable past my residence was 96 pair in 1961 but has been increased in number of pairs and sheath appears to be of another metal under the cable jacket. Lead was common as a sheath in the past, both for inert-to-exposure and some ability to deter chewing animals such as squirrels.

[9] Municipal building and electric codes for Los Angeles County have dictated new construction's wired utility distribution to be underground for the last three decades. The example is the commenter's residential area which began construction in 1961. Later sections of the neighborhood were constructed in the 1970s with all wired utilities underground. The Greater Los Angeles Area was one of the pioneers in implementing the National Electrical Code with such new standards.

high line and the physical support connections to insulators are of various types.[10]

Some of the lower voltage AC in the immediate area uses crossbars in addition to the topmost high line crossbars; elsewhere it is run as a three-wire in the vertical plane instead of horizontal. Spacings between television coaxial cable and telephone cable can vary from 0.2 meter to 2 meters. There is also some variation of the spacing distance to the lower voltage AC lines although a minimum seems to be about 1 meter. Uniformity only exists as to required minimums in physical separation. Steel guy wire supports exist where needed, 5 to 10 meters long, run from *dead man* buried weights to insulated connections to the wooden utility poles. Local subscriber power transformers may be located anywhere on a utility pole. All observed transformers have a metal casing.

The detailed description of a typical neighborhood is used to indicate the somewhat random physical location of elevated conductors. These conductive lines can act as parasitic conductors modifying incoming radio wavefronts.[11] If there is any RF radiation from the high line, such radiation may be modified in azimuth and elevation by the adjacent low voltage power line, or the telephone and television cables below that, or the conductive guy wires, or any other adjacent conductors such as street lamp posts.

While my neighborhood has utility poles and lines at the street edge, other neighborhoods in rectangular street layouts may have utility poles alongside an alley bisecting a residential block. There is no common layout other than original geographic layout that may have preceded the start of electric power distribution. This is true throughout most of urban centers in the United States of America.

In rural areas where only about 3% of Americans live and work, casual observation reveals that there is a greater variance in the type and styles of electric power distribution.[12]

Can Electric Power Transmission Lines Be Considered As *RF Transmission Lines?*

Only by the uninformed. Electric power transmission lines are standardized and built solely for the purpose of conveying very low frequency alternating current power from one place to another. That applies to all whether buried or elevated. Elevated power lines may ***look*** even and even neat but they lack the uniformity of physical dimensions that *RF Transmission Lines* require.

Uniformity in shape and dimensions insures a minimum of discontinuities. With RF transmitter sites, the purpose of the RF transmission line is to deliver RF power ***to*** the antenna rather than ***being*** the antenna.

An example of an RF transmission line ***becoming*** an antenna is found in two old wire antenna designs, the *Vee* and the *Rhombic*. Both antennas in their full form require a two-wire balanced feed line.[13]

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[10] Utility poles are prone to damage from vehicles in hillside areas and neighborhoods having several changes in direction. This commenter's residence is in the middle of a gentle turn and a street slope of about 8 degrees. The closest utility pole has been replaced three times in four decades due to vehicle damage.

[11] Most noticeable on observing signal strengths in mobile receivers while driving along a high AC power line. The Yagi-Uda antenna for VHF and higher is the first notable antenna deliberately using parasitic conductors to shape an antenna response in a single main direction.

[12] The 3% value is from U.S. Department of Labor statistics for 1994 and combined employment of fishing, farming, and forestry compared to a total of all employees in all industries and businesses. It is assumed that the ratio of employed to unemployed is about equal in all cases.

[13] The *half rhombic* is an alternate form described in U.S. Army Signal Corps literature for low VHF operation such as with the AN/PRC-119 SINCGARS family using 30 to 88 MHz.. It is literally half of a wire

With the Vee antenna, each transmission line wire angles out away from the straight-line path of the transmission line center. The ends of now-formed legs are unconnected electrically. The angle between the legs is usually 20 to 30 degrees. A Vee antenna may operate over a two octave wide frequency band and be bidirectional. A rhombic has its wires in a four-sided diamond pattern when viewed from above. The rhombic concentrates more power to the main lobe of the antenna pattern than the Vee and, if the narrow end opposite the feed point is *terminated* in a resistive impedance of about 600 Ohms, is essentially unidirectional. Bandwidth of a rhombic is slightly wider than a Vee. Wire rhombic antennas have been used in fixed-point to fixed-point radio circuits for over six decades with great success.

Each of the wire antennas simply splits apart the transmission line wires, a deliberate act of making the split one large discontinuity. While the balanced transmission line pair does not radiate much RF if properly terminated in its characteristic impedance, the simple split of the two wires does cause radiation.

Any discontinuity on an RF transmission line may become a radiating element if the balance of equal and opposite RF currents in the line is upset. Practice in radio communications transmission lines has been to ***minimize all discontinuities*** and maintain the line's characteristic impedance constant. That insures that the antenna itself receives maximum RF power and radiates same rather than the line doing some of the radiating and upsetting the antenna pattern.

If a balanced two-wire transmission line has one side made open deliberately, the part past the open then becomes an RF radiating element. That part acts like a single-straight-wire antenna.[14] Any conductor making contact with only one side of a balanced wire pair will upset the balance and thus be a discontinuity on the line and also radiate. Small conductor additions result in small radiations while large additions result in large radiations.

There is very little theoretical information in literature as to the effect of unbalanced conductors. One reason is that the shape and size of a discontinuity is almost infinite in variation. Another reason is simply *good practice of making the transmission line as uniform and constant as possible.* To reiterate, the purpose of a transmission line is to deliver RF power to the antenna rather than become the antenna.

Electric Power Distribution Lines Used As *Broadband RF Transmission Lines*

At first thought or glance this may seem a possibility. MegaVolt transmission lines seem to have great uniformity in shape when viewed in-line on open ground and stretching many kilometers away. Things are quite different in much smaller areas such as residence neighborhoods. The spacing between wires of a high line of 1 to 10 KV AC near a group of residences may appear even and constant. A few hundred meters in either direction may result in quite different spacings, even cross-overs of lines at unusual bends or corners. Actual spacings, essential to maintain characteristic impedance and minimum discontinuities, vary considerably.[15]

rhombic but the plane of the rhombus is vertical rather than horizontal as with HF wire rhombics.

[14] The old *Beverage* antenna used before the 1920s was nothing more than a single very long wire over earth ground. Lengths sometimes exceeded one wavelength even at very low frequencies. Note also: Antennas receive as well as transmit RF energy; in that their action and operation are considered bilateral and receiving antenna patterns are considered the same as transmitting antenna patterns.

[15] Actual dimensions may be verified with any electric power public utility but those allow a variation in practice as described in local codes. Casual observation can use common residence dimensions (10 feet for one story) as comparative values when both utility poles and a residence are at the same distance.

AC power distribution lines were **never designed nor characterized for constant characteristic impedance operation**. Their operating frequency (in North America) is 60 Hertz. Higher voltage lines must be separated for safety, not for any RF transmission purposes over a 5-octave RF bandwidth (3 to 80 MHz). Wires must be large enough to carry the maximum current load allowed. There is no skin effect at 60 Hz and no need to minimize conductive discontinuities, therefore support devices around insulators, even taking a turn of wire around an insulator, do not affect 60 Hz power line frequencies. Spacings can vary at the convenience of the installers as long as they are greater than safety standard minimums. Other than for esthetic reasons to show good workmanship, there is ***no reason to maintain constant spacings and sizes of wires at 60 Hz.***

The frequency range of Access BPL was stated as approximately 4 to 80 MHz in NOI 03-104. Wavelengths of that range are about 75 to 4 meters. High-line to local distribution step-down transformers in elevated AC distribution systems may be located somewhere on 10 meter utility pole or at ground level adjacent to the pole. Further, that transformer is ***not characterized for operation above 60 Hz. It has no reason to be.*** Yet, the primary winding connection from high-line to transformer may be somewhere between 2 and 12 meters long. At 4 to 80 MHz, that transformer primary may represent an open circuit or a short circuit or some impedance in-between. The connecting wires to the primary winding can thus be a familiar (to VHF and below RF workers) a *stub tuner* that can frequency-selectively alter whatever the characteristic impedance of the high-line. That stub section of line will exist at varying lengths about every 10 to 20 residences. That is not a controlled condition, but there is ***no need for such control at 60 Hz.***

What can be characterized at RF from 4 to 80 MHz in a typical, existing overhead AC electric power distribution system is a gamble, a crap-shoot, a slot-machine answer for a grossly approximate RF characteristic impedance with no control over discontinuities than can stretch out in almost random directions for tens of wavelengths at the lowest BPL frequency. Worse, those grossly approximate RF conditions can themselves change between communities and cities having slightly different codes and work techniques from one another. At Access BPL frequencies it is a terrible ***unknown.***

Will a rural electric power line work with Access BPL? Probably, but that hinges on it being a single wire pair installed at about the same time by the same utility or company. Chances are that such will have fairly uniform spacing of wires, the same wire sizes, about the same height above ground. With few tap-offs for other parallel distribution lines the number of discontinuities will be minimal...but there ***will be discontinuities*** that still have the potential to radiate broadband noise over HF and low-VHF. The minute that a single transmission line splits into two lines going in different directions, it exacerbates the discontinuity situation through an RF mismatch of characteristic impedance and has the capability of radiating more RF from the BPL data signal.[16]

Can An Electric Power Transmission Line Also Become A Broadband RF Transmission Line?

Yes. It is theoretically possible. But, the cost would be astronomical since large, multiple urban areas would require an almost total retrofit/rebuild of the existing electric power distribution system to one that is standardized, characterized to well-known RF transmission line theory. Only a small rural electric power line has any practical hope for success. However, that awakens the spectre of minority-over-majority rule.

If 3% of the population (of rural regions) are advantaged, yet the remaining 97% of the citizenry are

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[16] No one can simply parallel a pair of RF transmission lines and expect the characteristic impedance to be unaltered. Basic RF textbook situation. It makes no difference at 60 Hz where the wavelength is about 5000 km or 3107 statute miles. A 10 km transmission line is only about 0.002 wavelengths at 60 Hz...but it is 100 wavelengths at 3.0 MHz, a thousand wavelengths at 30 MHz.

disadvantaged from pseudo-random HF-VHF noise pollution, is the Commission working for the national good? The Commission's regulations on civil sources of incidental RF radiation affect ***all citizens,*** not just a tiny percentage of the population**.**

Other Considerations For Access BPL Systems

In the infrastructure of electric power distribution in urban areas (the majority of the population) having existing overhead lines and utility poles, it is inevitable that repair and replacements must be affected due to unforseen events such as vehicle collisions. If an Access BPL system is installed, repair or replacement of power lines ***must be followed by radio frequency interference measurements*** to insure compliance. Power lines are open structures with no possible containment of any RF fields. In contrast, telephone and television cables all work within shielding and are replaced (if need be) by similar shielded replacement cable sections using mature repair procedures. Using electric power lines as RF transmission lines is a new art and there is no new standard of repair work procedure to follow; such would have to be worked out during the expected time-span of normal aging. This is new ground and other utilities are of little help. Other utilities are mature art. Access BPL is brand new.

Indeed, there is ***little information disseminated*** to general electronics workers on details of any Access BPL system proposed. All that we in the electronics field can find is a number of very general statements, little more than public relations puffery that has already colored the Comments on NOI 03-104.
No one can effectively judge the efficacy of any Access BPL system without details. For example, what is the broadband signal level along the main distribution route?

The main broadband data signal level is driven by the expected losses in taps and couplers relative to the required signal level at the end of a subscriber's drop. The main broadband signal level would have to be, at a minimum, the subscriber's signal power level plus all the expected losses. There is no loss figure given on any system in the electronics trade press, much less details of any system.[17] Broadband data carried on high voltage AC power lines requires connection with very non-standard devices having great working voltage limits. Would the loss, even a deliberate loss such as in the non-contact tap of cable television be 20 db? 30 db? 40 db? 50 db? One can assume that the highest signal level in Access BPL would be the determiner of any incidental radiation from the system. At best, we can only speculate and speculation is improper for setting down federal regulations.

There is only a presumption that any Access BPL subscriber end-of-drop signal level would be similar to an existing personal computer interface or peripheral. If the drop-end signal level is 10 milliWatts peak power and the total coupling loss or level shift is 40 db, the main Access BPL distribution power level must be 100 Watts peak. The majority of amateur radio HF transceivers' transmitter power output is 100 Watts.

While the stated 40 db coupling level shift seems exaggerated, it is itself speculative. Without data on the system parameters are purely speculative at this point. At best, we might draw some conclusions from the 4-decade old mature cable television systems. Typical non-contact probe couplers have an approximate 20 db level shift. Wideband dedicated signal amplifiers along the cable way have, at most, about a Watt of

[17] This is referenced to widely-read controlled circulation (subscription free) publications such as *EDN, Electronics Design, Microwaves & RF, RF Design, EE Times* as well as many Internet sites having technical support over and above the usual salesmanship gloss. To the extent that the *IEEE Spectrum* is free to any IEEE member and that *Spectrum's* technical content is both detailed and superior, I would not hesitate to include it as part of the widely-read controlled circulation periodicals. Individual *Proceedings* and *Transactions* of IEEE Societies is an extra cost over and above IEEE membership dues.

RMS power with perhaps 2 milliWatts of signal power per channel. A 20 db level shift would result in 20 microWatts per channel (38 milliVolts in a 75 Ohm system), well within good signal-to-noise ratio of a television receiver plus allowing for some losses within a subscriber's location plus a fudge factor based on a long history of cable television operation. Cable television distribution systems have about a 900 MHz bandwidth, quite enough to qualify as being broadband.

The difference between existing cable television systems and Access BPL seems to be in cable television as essentially one-way, incoming only service while broadband to the Internet must be two-way.[18] Cable television signals work with existing television receivers which have good signal-to-noise ratios with signal levels as low as 100 microVolts per channel. For any Access BPL incoming broadband signal to be that low a level would require each BPL subscriber to have a peripheral with considerable internal amplification, akin to a cable subscriber's set-top box.

Access BPL outgoing (from the subscriber) signals would be required to overcome coupling losses or signal level changes to reach the head end. No such signal level data is available to the general public, therefore one can only conjecture. Given the previous speculative scenario with 40 db power level change, the outgoing Access BPL signal would have to be at a 10 Watt power level to achieve a 1 milliWatt head-end power level. The 10 Watt level would be at the subscriber end and itself under scrutiny for incidental RF radiation. The downlink power level versus uplink power level on the main Access BPL route would then be 100 W to 1 mW or 50 db. For asynchronous data flow that would be a most difficult task.

In all due respect, I do not believe that Access BPL coupling losses or signal level changes are as high as I stated but, without systems parameter information, it is possible. NPRM 04-29 fails to state any sort of quantitative values of RF signals carried on any proposed Access BPL systems...nor does it reference any source of such information available to the general public or to the electronics industry.[19] Quantitative values cannot be withheld as some sort of proprietary secret process when incidental radiation - of some value - can be expected to affect hundreds of thousands of citizens affected by such incidental RF radiation or directly involved with Access BPL.

The RF power level and signal characteristics on the main Access BPL transmission line will be the determining factor for incidental RF radiation levels.

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[18] Receive-only at a subscriber end is how cable television began. When premium, extra-cost channels were added, subscribers could telephone into an automated telephone terminal to order a premium channel viewing for its time available (*pay per view* service). Two-way communication along the cable run allowed such service to be included in a subscriber's terminal box (also called *set-top box*) plus paving the way for uplink services such as broadband data transmission to the head end on frequencies below 54 MHz. With digital cable television service the formatting and signal level and characteristics for uplink transmission are withheld deliberately. This seems due to thwarting *hackers* seeking Internet access without paying for it. A technical investigation - sometimes referred to as *reverse engineering* - that may be determined empirically but at considerable expenditure of time.

[19] Citing an obscure or hard-to-get source of technical information as the major reference is not an unknown technique used by proponents of anything. In an intellectual environment of tens of thousands of diverse information sources, themselves infected with great quantities of self-promotional phrases, the time spent in winnowing a small amount of wheat from tonnes of chaff is prodigious. Technical considerations should not be made on the basis of emotionally-loaded generalities or promises. That is the purview of politicians. QED.

On Considerations Specific to NPRM 04-29

It is assumed that, in the words of Mr. Richard E. Polivka, passage of Access BPL is already a ***fait accompli*** and all citizens of the United States of America are to have it.[20] The following Comments regard specific questions raised by the Commission in NPRM 04-29.

Definition of *Access BPL*

I would request the Commission to strike the word *energy* in its first sentence and substitute the word *communication*. This avoids any confusion between electric power (primary energy being conveyed on electric power lines) and the lower-energy-level communications being proposed to be carried over those same lines.[21]

The Commission regulates *communications*, not the distribution of electric power energy.

Continuation Of Existing Part 15 Radiated Emission Limits

I heartily agree with that and for the reasons given with some comment on the Commission's last sentence.[22] The Commission states "*...we are proposing that Access BPL devices include technical capabilities and administrative procedures to ensure that the potential for harmful interference is minimized and that any instances of harmful interference are quickly resolved.*"

It is this commenter's opinion that a ***technical description*** of an installed Access BPL system or systems be made available to the public. An example of such technical description is that of the National Television Systems Committee (NTSC) on older analog television broadcasting. This need not be in Part 15 but can be referenced to an organization as in the case of Digital Television (DTV) broadcasting technical standards. The reasons are many.

As new technologies are developed - largely unannounced in the beginning - they need information on the environment they must work in. A readily available Access BPL technical description document is necessary to development of new technology.

Administrative procedures alone opens a veritable Pandora's Box of potential conflict. Despite the excitement of the Commission over Access BPL, there has already developed a very large, very vocal group of antagonists who either use HF and low VHF or enjoy listening to same. There appears to be much resentment already generated over this new national noise source to be. Commission field offices as well as the Consumer Hot Line on the Internet site can be expected to receive a growing number of complaints and demands to measure the interference the complainants allege. While most may be mistaken or unknowning, the Commission has no *a priori* knowledge for judgement.

Quick resolution (of harmful interference) can only be done by advance preparation. Despite the Commission's excitement on bringing the Internet to 3% of the citizenry, the other 97% of our country will be a breeding ground for discontent.

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[20] Comments on ET Docket No. 03-104, ET Docket No. 04-37, by Richard E. Polivka in the ECFS indicated as received on 3 March 2004 as given in his next-to-last paragraph.

[21] NPRM 04-29 at 32

[22] NPRM 04-29 at 33

On Interference Concerns

The Commission states "In this regard, we note that hundreds of kinds of unlicenced devices are successfully operating under the current Part 15 limits without causing harmful interference to licensed operations."[23] While the first half of that quoted sentence is correct, it implies that Access BPL systems that can spread over much of any urban areas "are the same as" an individual pair of through-the-power-lines wireless telephone jack extensions. That implication is woefully incorrect.

First of all, individual unlicenced devices that operate over 4 to 80 MHz are limited in kind. Secondly, most of those operate through conduction in the building primary power wiring. Narrow-spaced wires (such as "Romex" cable) or loose individual wire in grounded metal conduit are not good RF radiators...even if a section of building electric wiring is near the end of a run and the remaining wire becomes resonant at some operating frequency. All such devices are contained and constrained to the building interior. Access BPL systems can spread out for hundreds of blocks in all directions and the potential radiating element is elevated and away from all buildings. That is a rather obvious difference.

Small unlicenced devices can be considered as pseudo-random, nearly isotropic noise sources. From statistics and the statements in all electronics texts regarding noise sources, all noise powers add. The number of such "noise sources" (unlicenced devices) in a use-crowded environment such as an Information Technology center's room may not be as many as 100 units. Any Access BPL system will encounter <u>thousands</u> of such "noise sources" just from the discontinuities along any high-voltage electric power distribution line.

On Exemption of Conducted Emission Limits and AM Broadcast Band

Exemption of conducted emission limits does not seem to pose any problem to me as long as the radiated emission limits are ***kept at or below existing limits.***[24]

The thought of consumer electronics quality couplers/bridges connected to my 4.4 KV power distribution line and dropping into my house would - immediately - forbid any consideration of subscribing to same. While we in southern California are not subjected much to lightning storms, those rare cases could be attracted by the grounded common line at the center of the 4.4 KV set also carrying Access BPL Our telephone service drop terminal box has an overvoltage shunt for such electrical storm static build-ups but the telephone line pairs arrive bundled in a sheathed, shielded cable, low on the utility pole.

There should be ***no need*** to permit any Access BPL system operating frequency below 1.8 MHz. If the overwhelming majority of United States citizens must be forced to live with a national noise polluter, then at least, allow us some freedom to tune in AM broadcast stations.

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[23] NPRM 04-29 at 34

[24] NPRM 04-29 at 38.

Equipment Authorization

I cannot agree with the Commission's decision to treat Access BPL systems under a simplistic Verification procedure.[25] While an Access BPL head-end terminal may be the size of a personal computer and a subscriber's terminal may be the size of a Phoenex plug-box, the ***entire electric power distribution wiring in an urban area can be a massive antenna covering many square miles.*** That is precedent-setting and goes beyond the size of even the largest installed wire-and-tower antenna field in the nation. The number of discontinuities and thus potentials for RF radiation are many in such a large field.

Additionally, that equivalent antenna system may have amplifiers along its length to maintain a design minimum power level along the Access BPL service route. Such a system is akin to a "super Beverage antenna" fed from a very wideband RF source. That is almost the description of early "spark" transmitters connected to as long an antenna wire as possible except that RF power levels are not nearly as strong as in the very early days of radio. However, HF and low VHF receivers are certainly much more sensitive now than before the 1920s.[26] While the existing Part 15 incidental RF radiation levels are very low, modern receiver sensitivity is also very low. That seems to align.

It is my feeling that any Access BPL **system** should be treated to a proof-of-performance measurement test by an independent professional engineering organization much the same way that a broadcast station must show its coverage capability. This would be similar to the more stringent requirements of broadcast stations having more tests for directional antenna operation than those with omnidirectional patterns. The difference would be in many and varied geographic locations of measurement where measured RF fields must be below specified limits rather than above them..

Urban areas will bear the brunt of possible excess RF incidental radiation. Over nine-tenths of the nation's citizens reside there. Of those urban areas, residential zones would be expected to have the majority of lower-cost receiving equipment and amateur radio operators. By visual observation, the existing electric power distribution system while will carry Access BPL signals, remains the overhead with utility pole system.[27]

An Access BPL **system** breaks new ground in both use and regulation. The potential for excess RF emissions can exist over the area equivalent to a medium-sized city. The initial **system** installation should be thoroughly checked at many locations. Since any Access BPL system must use existing electric power distribution lines and that those lines were never standardized for this sort of use, prudence and logic would indicate that a thorough systems check in the beginning will alleviate later disputes about interference claims.

Given the much-improved equipment life and stability of modern semiconductor electronics as well as the stability of the existing electric power distribution infrastructure, after-installation measurements would be considered only for investigation of interference complaints. It must be pointed out that all Access BPL systems will affect over nine-tenths of the population insofar as incidental RF radiation is concerned.

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[25] NPRM 04-29 at 40.

[26] A typical modern receiver sensitivity over HF and low VHF is less than 1.0 microVolt for a 3 KHz bandwidth and better than 20 db signal-plus-noise to noise ratio. Very early radio receivers having no active devices might have just-discernable input signal levels of about 50 milliVolts, as with a Fessenden "heterodyne" receiver using a small "spark" RF source as a sort of local oscillator. This is conjecture based on descriptions of early equipment with unknown selectivity of the antenna-plus-tuned-detector combination.

[27] From personal observation in the states of California, Arizona, Nevada, Texas, Missouri, Illinois, Wisconsin, Minnesota, South Dakota, Montana, Wyoming, Washington, Oregon, Utah, Colorado during the years 2001 through 2003, in both urban and rural areas thereof..

Measurement Guidelines[28]

An installed Access BPL **system** will cover a large variety of locations, everything from inner-city "concrete jungle" (literal concrete) environments to more open vegetation-filled residential areas and all manner of combinations in between. It is quite probable that city center environments will have buried utility lines of all kinds while residential areas tend to overhead lines for distribution. Concrete is somewhat porous, both to water and to radio waves at VHF and below. As such it may or may not influence of below-concrete conductive structures such as metal pipes, structural steel, or even access tunnels for other utilities. The same might be the case for small trades business areas, stores, and offices having landscaping surrounding a building complex. Residential areas are more benign below ground level, consisting mainly of utility lines (fresh water, natural gas, waste water pipes plus telephone, television, and electric power lines if burial is required by zoning laws), perhaps some metal irrigation pipes (non-conductive plastic lines seem to be the norm).

For measurements below 30 MHz done with a magnetic field loop antenna, I will suggest the bottom of the loop be 8 to 10 feet from walking surface. While such dimensional distance is a quarter wavelength at about 30 to 24 MHz, respectively, the height above walking surface would serve to lessen the effects of magnetic field distortions from hidden, underground conductors. Most television receiving antenna masts are in 10-foot lengths, supplied capable of stacking with other mast sections.

From the outside of a typical one-story dwelling, an 8 foot elevation from exterior walking surface is approximately the height of tips of extended portable radio whip antennas and television receiver "rabbit ears."[29] Exterior magnetic loop antennas at an 8-foot-above-walking-surface height would approximate the heights of expected interference-receiving devices inside the dwelling..[30]

The large variety of HF-range exterior antennas in residential areas requires a uniform height of field measuring antennas so that potential interference claims can be judged via interpolation. This is predicated on future complaints coming largely from residential areas.

Radiated Emission Measurement Principles for Overhead Line Installation[31]

The measurement methods outlined in Appendix C.2.b.2 are confusing and need some clarification.[32] An Access BPL system operating on already-installed overhead electric power lines

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28 NPRM 04-29 at 46 and Appendix C.2

29 Presumes a 2-foot rise of interior dwelling floors from average ground level. While some dwellings are only a half-foot above ground level, others can be up to 4 feet above ground level. Average dwelling heights of ceilings are close to 8 feet from floor, the common length of drywall or plywood sheeting.

30 No useable data is available to the commenter confirming the validity of this height other than some work done for companies who consider that proprietary data. The combined weight of a 3-foot diameter aluminum tubing loop and an 8-foot length, 1 inch diameter polyvinylchloride pipe is approximately 30 pounds with RG-58 coaxial cable attached. This was comfortable for an average human male to carry while walking around an RF field, taking measurements. A leg arrangement for self standing support should not weigh more than about 5 pounds extra.

31 NPRM 04-29 at Appendix C.2.b

32 In the first sentence of C.2.b.2, a distance of "0 wavelength" implies a direct connection.

must contend with the non-uniformity of such lines for RF transmission line purposes. While a uniform balanced-pair RF transmission line could possibly be successfully measured at quarter-wave intervals to one wavelength at mid-band, that does not account for discontinuities resulting from varying spacings, splices along the line, cross-overs and parallel connections to other lines, and all other structuring not found with RF transmission lines employed for radio transmission and reception.

It is my feeling that C.2.b cannot be firm until some extensive measurements have been done on the incidental radiation of the four test site installations (to date) of various Access BPL systems. Access BPL systems are *new territory* insofar as the possibility of incidental RF radiation. There is no precedent to fall back upon other than some very ideal RF transmission line models. Utility electric power lines already installed are far from ideal RF transmission lines.

Summary

While Access BPL systems have a seeming potential for communications good in the future, they also have an unknown potential to be very bad for existing HF and low-VHF band users and general citizenry. All of the Commissioners' statements of enthusiasm cannot negate the seeming fact that they have disregarded technical basics of RF transmission lines in proposing such use in an infrastructure of installed electrical power transmission that were never designed nor installed as RF transmission lines. The enormous equivalent antenna field of any urban Access BPL system makes it a likely source of radio frequency interference to all civilian and governmental radio receivers in such an area. Excitement over new, untested technology cannot be a judgement call to negate all present users of the HF to low-VHF radio spectrum.

Access BPL systems are new territory in potential RF radiation sources as well as a way to provide wired communications to broadband data subscribers. Since at least two other major wired systems already provide such broadband service and a third, "WiMax" (IEEE 802.16 standard), promises to do that by wireless means up to 30 miles, Access BPL does not appear to be either exciting or interference-quiet as a competitive fourth broadband dissemination method..

Access BPL systems are new territory as yet not fully explored in theory or in practicality. The existing test sites of various Access BPL systems in the USA should be measured in detail to prove out the systems in regards to incidental RF radiation with attention paid to the variation in existing utility electric power lines used as RF transmission lines, something they were not designed to do. Only then can some viable incidental radiation regulations be formulated.

I thank the Commission for allowing an independent citizen's viewpoint to be heard and with the ability to share a half century's accumulation of experience and knowledge in radio and electronics towards proposed rulemaking.

Respectfully submitted this 9th day of March, 2004,

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